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DDC 10 YEAR REQUIREMENTS AND PLANNING STUDY

Interagency Survey Report

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A survey was conducted by personal interview of 14 agencies of particular interest to DDC to assess the national technical information environment as it relates to DDC. The effort was an initial phase of an overall study to develop technical objectives for DDC during the 1978-1988 time period. It is intended to provide a review of facts and issues pertinent to preliminary, short-term interagency interface planning by DDC.

A general projection was made of the goals, objectives, operations, services, and structure of the technical information environment with which DDC will most probably interface in the decade 1978 to 1988. Findings are structured in four general categories: Technology, Organization Structures and Affiliations, Economics and Marketing, and Scope of Services.

The 14 selected agencies were initially contacted by telephone. Either the agency director or chief technical planning officer was invited to participate in the study. No organization contacted declined to participate. The interview was conducted on-site for approximately 1 hour.

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SECTION I. INTRODUCTION AND SUMMARY

This Interagency Survey Report represents the results of AUERBACH Associates' findings, observations, and analysis of the current and projected national technical information environment as it relates to the Defense Documentation Center (DDC). The conclusions discussed herein are based upon a survey of fourteen agencies that are of particular interest to DDC (see Appendix A). This report completes the first phase of an overall effort to develop technical objectives for DDC during the 1978-1988 time period. It is intended to provide a review of facts and issues pertinent to preliminary, short-term interagency interface planning by DDC.

This document is the final technical report on the Interagency Survey portion of Contract No. DSA900-75-C-5161. It does not represent AUERBACH's final recommendations with regard to DDC programs. These are to be included in a subsequent report.

1.1 PURPOSE AND OBJECTIVES

The purpose of the Interagency Survey has been to develop a general projection of the goals, objectives, operations, services, and structure of the information environment with which DDC will most probably interface in the decade 1978 to 1988.

The Interagency Survey had four objectives:

1. Survey and evaluate a select group of scientific and technical information (S&TI) and research, development, test and evaluation (RDT&E) management information transfer sources.

2. Define the current and projected S&TI and RDT&E management information environment external to the DDC information transfer process.

3. Identify S&TI and RDT&E management information interfaces and problems that will affect DDC's posture in the future information transfer environment.

4. Define the current and projected interagency structure for S&TI and RDT&E management information community including the role of DDC in this structure.

Objective 1 was satisfied through the accomplishment of the survey itself. The methodology of the survey is described below in Section 1.4 and the findings regarding the individual agencies surveyed are described in Appendix A. Section II of this report is directed toward satisfaction of Objectives 2 and 3 through definition of the current and projected S&TI and RDT&E management information environment, interfaces, and problems. Section III defines the role for DDC in the projected S&TI and RDT&E management information community, and is thus directed toward Objective 4.

1.2 SURVEY SUMMARY

As a result of the Interagency Survey, AUERBACH has arrived at the following conclusions:

- Overall

  DDC's role within the interagency environment is secondary to the fulfillment of its primary mission to serve the DoD RDT&E community. A tertiary consideration is its role in advancing the state-of-the-art of information processing on a national scale.

- Technology

  DDC's technological roles involve exploiting the full potential of state-of-the-art technology in support of RDT&E decision making processes. DDC can develop improved tools to assist in this process, identify inadequacies in the state-of-the-art, and act as a stimulus in overcoming recognized inadequacies.

Related observations:

- Technological problems of the information processing field are not as significant as organizational and economic factors and problems in the definition of the scope and nature of services

- Currently available technology has not yet been fully exploited by the information community

- Communication among independent information agencies affords the opportunity for highest payoff in improved S&TI services

- Organizational Structures and Affiliations

DDC must consider two organizational interfaces: one within DoD and one external to DoD. DDC's role is to act as coordinator of information programs and DoD's purveyor of information. The RDT&E management information needs DoD-wide coordination. DDC needs to establish formal agreements with external information agencies to ensure that a broader spectrum of S&TI services is provided to its users.

Related observations:

- There is no unified, consistent structure to the Federal information community, and this condition will persist for the target period (1978-1988).

- This situation will be aggravated by conflicts over processing standards and the unresolved issue of public versus private rights to information.

- Parochial interests of the military management information programs will have to give way if effective RDT&E management information systems are to be implemented.

- Localized information services and decentralized systems will be the dominant organizational trends in the 1978-1988 decade.

- Economics and Marketing

DDC can benefit, as can its peer agencies, if it can develop and apply econometric measures to information services. Marketing of DDC products and services is a two way process: it involves education as well as obtaining user feedback.

Related observations:

- No value measures of information have been developed which would be useful in making economic decisions. Information has subjective and pragmatic value to its users, but this value has been difficult, if not impossible, to measure to date; thus,

- Information agencies need new econometric measures (or new applications of existing models) to justify the new or increased revenues needed to meet stepped-up service demands

- Improved marketing efforts are required in order to ensure that users realize maximum benefit from current and future investments in information systems.

- Scope and Nature of Services

DDC needs to broaden its scope of services to satisfy a wider range of DoD information needs. To do so, it should define its audience and the requirements of this audience, and develop new specialized products to meet these requirements.

Related observations:

- New concepts in both S&TI and RDT&E management information systems are required if these systems are to be more directly relevant to decision-making processes.

- DDC's sole reliance on DoD technical reports for its S&TI information base is at variance with the policies of the S&TI community at large.

1.3 AGENCY SELECTION CRITERIA

Through the mutual efforts of AUERBACH and DDC, fourteen agencies (see Appendix A) were selected to represent the S&TI management information environment with which DDC will interface in the target period of the study. This number was mutually agreed upon as a representative sample size. The organizations were chosen according to specific criteria. In order to be selected for inclusion in the survey, an agency had to:

1. Demonstrate that it used state-of-the-art techniques for information handling

2. Reflect the broad range of information handling activities of interest to DDC

3. Be representative of military or civilian agencies

4. Process S&TI, RDT&E management information, or both

5. Preferably, have a national service scope

6. Preferably, have a mission or objectives that parallel those of DDC

All agencies included in the survey are Federal Government information transfer organizations.

1.4 SURVEY METHODOLOGY

The fourteen selected agencies were initially contacted by telephone. Either the agency director or the chief technical planning officer was invited to participate in the study. No organization contacted declined to participate.

A date was scheduled for a one-hour, on-site interview. Follow up letters with brief project descriptions that referred to DDC as the Office of Primary Responsibility for the contract were sent to the interviewee, when requested. Military agencies generally preferred such letters.

The survey technique used was a focused interview, conducted by one or more experienced, senior members of the team. The one-hour schedule was called to the interviewee's attention at the beginning of the interview and again at the one hour mark, but the interview was actually terminated at the convenience of the interviewee. Most interviews lasted one hour. One was terminated early and several continued for more than two hours.

At the outset of the interview, each interviewee was asked for copies of any agency planning documents. Descriptive documents of operating systems were also collected to minimize interview time.

Next, the interviewer outlined the purpose and objectives of the study, described the study methodology, and explained why the subject agency had been selected for the study.

A one page outline of the interview was then presented to the interviewee. It listed three leading questions to be answered about the agency:

1. Where are you today?
2. Where do you plan to be by 1988?
3. How will your agency fit into the information community as you envision it in 1988?

The questions were to be focused on four areas of concern (see Appendix B).

1. Technology
2. Organizational Structure and Affiliations (formal and informal)
3. Economics and Marketing
4. Scope and Nature of Service

    a. Content
    b. Audience
    c. Products and Packaging

Using the specific issue areas described in Appendix E as a guide, the interviewer then probed those issues that surfaced as key to the programs and plans of the subject agency.

The results of the interview, the documents provided by the agency, and the open literature were then used as a basis for analysis and development of the recommendations presented in this document.

The results of the Interagency Survey will be incorporated into the main course of the study (now in progress) to characterize the interagency information environment as a factor in developing time-phased objectives for DDC during the 1978-1988 period.

1.5 ORGANIZATION OF THE REPORT

The remainder of this report is in two sections:

- Section II defines the S&TI and RDT&E management information environment, interfaces, and problems
- Section III defines the role for DDC in the projected S&TI and RDT&E management information community

Individual descriptions of the organizations surveyed are provided in Appendix A. Appendix B contains the Interview Guide and supporting materials used during the conduct of the survey.

SECTION II. S&TI, RDT&E MANAGEMENT INFORMATION ENVIRONMENT, INTERFACES AND PROBLEMS

This section defines the Defense Documentation Center's (DDC) scientific and technical information (S&TI) and research, development, test and evaluation (RDT&E) management information environment. It consists of AUERBACH's conclusions drawn from the findings of the Interagency Survey.[1] It is intended to characterize the information environment external to the DDC, which includes the interagency structure external to the Department of Defense (DoD) and the information structure internal to DoD.

The conclusions presented in this section are problems and issues that need to be faced by DDC personnel who will implement DDC programs compatible with the information environment of 1978-1988. The conclusions of Section II are addressed by the recommendations of Section III which define DDC's role within the projected information environment.

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[1] See Appendix A for detailed findings regarding the fourteen agencies represented in the interagency survey.

The following topics are covered in both sections.

- Technology - automation and information handling techniques
- Organizational Structures and Affiliations - interagency relationships and selected problems
- Economics and Marketing - costs, values and awareness programs
- Scope and Nature of Services - trends in information services and products

2.0 SUMMARY OF THE INFORMATION ENVIRONMENT

There are two facets to DDC's S&TI and RDT&E management information environment. One facet relates to the information structure within DoD, which consists of

1. the S&TI component (DoD scientific and technical personnel, contractors and grantees)
2. the RDT&E management information component (DoD RDT&E program managers and planners)

The second facet relates to the interagency environment for S&TI and RDT&E management information external to DoD. The external environment has no formal structure and no common operational organization. It consists of a community of Federal agencies, scientific societies, commercial firms and other information processors all dealing with the same information issues in various ways. Among the members there are similarities, differences, (and sometimes conflicts) in their individual organizational objectives and values.

Conclusions regarding both the internal and external facets of DDC's information environment (i.e., the DoD information structure and the interagency environment) are summarized in this Section.

2.1 TECHNOLOGY

Those interviewed in this survey agreed that technological problems were secondary to other considerations in improving S&TI and RDT&E management information systems. But of the technological issues which surfaced, the following are of importance and are fully summarized in sections 2.1.1 through 2.1.10:

- Diversity of systems as a hinderance to interagency interfacing and system use
- Leadership of information agencies as a key to advancement of technology
- Development of more efficient means of simultaneously handling interactive computer processing
- Emergence of decentralized systems to alleviate demand on central units
- Development of software to handle large files while optimizing machine utilization
- Development of basic file design principles for S&TI and RDT&E management information systems
- A trend away from dedicated and toward dial-up communications lines for interactive retrieval
- Use of mechanization to reduce human error
- Full text document dissemination

2.1.1 Significance of Technology

Information processing technology which is currently available is not being fully exploited by the S&TI and RDT&E management information community, according to a consensus of systems analysts and information systems managers surveyed. Instead of looking to future technologies, systems designers should plan to utilize those which are state-of-the-art, and to further the development of these.

For example, computer configurations which optimize simultaneous batch and interactive processing are being used in the banking industry, but not in S&TI systems. Another example is the ability of commercial television sets to act as a CRT terminal when linked to a relatively inexpensive keyboard and telephone coupler. These examples point out the need for further capitalization on existing technologies, since these are currently five to ten years ahead of the ability to use them.

2.1.2 Diversity as a Hinderance to Interagency Interfacing

Inconsistency in systems designs and operations confounds the potential for interagency interfacing. Since each major information system has evolved

at different points in time to meet different objectives, the technologies these systems employ are not readily transferrable to other system environments.

Previously, the diversity among systems resulted in progressive improvements. Today, however, the sheer number of diverse methods of system operations has resulted in difficulties of information exchange among agencies. In the decade 1978-1988, this situation may be alleviated through standardization of system components, allowing for increased transfer of information technology among agencies.

2.1.3 Diversity as a Hinderance to Use

Inconsistency among systems has also resulted in adverse effects upon users, presenting them with an uncomfortable sense of confusion. Occasional users cannot be expected to be fully conversant with all variations of the special tools (i.e., use protocols, on-line commands, terminal configurations, vocabularies, data elements, etc.) of a wide variety of diverse and sophisticated retrieval systems. User education programs and on-line tutorials are effective in improving user awareness of a specific system, but are of little effect in improving use in the information melange which currently exists.

The standardization of system components (mentioned above), coupled with developments in artificial intelligence (currently under investigation at ARPA) should ease the burden on users in the 1978-1988 period.[1]

2.1.4 Technological Influence of the Information Community

The information agencies surveyed tend to use general purpose technology in their operations. General purpose computers, such as those used in common business applications, for example, provide the bulk of the computing power for the agencies represented in the survey. Collectively, the information community is large enough and important enough to influence further technological development which would be more advantageous to information processing. The development of certain processing equipment, software packages, information networks and machine readable indexes give evidence to this influence.

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[1] Further discussion of this topic may be found in: Sauter, Hubert E. DDC Long Range Objectives FY 76 through FY 86. Memorandum dated 4 April 74, p. 1-2.

When key agencies provide clear leadership to overcome the fragmented nature of the varied technological objectives and requirements of the field, useful technological improvements are likely to occur. Several key agencies acting together can have a significant impact upon the development of hardware, software, communications and document handling technology.

2.1.5 Interactive Input and Retrieval vs. Batch Processing

On-line, interactive computer systems are in common use for both interactive input processing (e.g., INFOCEN) and search and retrieval (e.g., NLM, NASA, ERDA, etc.). There is great interest in developing better interactive input systems, such as machine-aided indexing, but for some time yet to come noninteractive batch will be the primary mode of computer input processing for the agencies represented in the survey.

These two processing methods put different stresses on the central processing systems. A common complaint of those interviewed was that no efficient machine has yet been designed to handle batch as well as interactive processing simultaneously. Attempts to resolve this problem have resulted in efficiency compromises. But, compromised systems are now at the point where they will have to upgrade their computing capability or at least recognize a limited growth potential.

2.1.6 Decentralized Systems

Decentralized and distributed processing systems are an alternative to large centralized systems. Distributed processing systems alleviate demand on a central system and perform either preprocessing or post-processing at remote sites. Intelligent terminals, word processing equipment, mini-computers and local document collections contribute to this growing trend. The most notable examples of distributed processing are seen in the R&D management support systems of the military services and the preprocessing of documents and document surrogates submitted to NTIS by other government agencies.

Flexibility and mid-stream modification possibilities provided by distributed systems are attractive from a design standpoint, especially at a time when no one wants to commit themselves to a comprehensive master system.

2.1.7 Software for Large File Management

Software and design structures for organizing and maintaining large scale (10^{10} to 10^{15} bytes) files are in an elementary stage of development. Information specialists and computer scientists are both beginning to work on the problem in the way programming languages were worked on in the 1960's.

Information scientists in all surveyed systems are looking for techniques to help structure the intellectual content of systems in ways corresponding to the probable use of the files. Most attempts to limit the accessibility of subsets of the files have met with considerable opposition. More success has been achieved by systems (such as INFOGEN) which make the file structures rather transparent to the user.

Computer scientists are working on efforts to optimize machine utilization through efficient file index and manipulation techniques.

2.1.8 File Design for Information Systems

The organization and representation of information files is still one of the key problems under wide investigation. In size, nature, structure and use, they are inherently different from files used for manipulation of routine business records and scientific calculations. There is little agreement on basic principles of S&TI file design. Controversy exists even on the appropriate content of such files. The issues of free text search versus controlled vocabulary, the level of indexes, the storage and dissemination media for abstracts and full text, the value of data tagging and the use of special files of actual data rather than bibliographic citations are unresolved.

The lack of progress in file design is also evident in the development of management information systems. Data files of high reliability are critical for rational management decision making. Principles of information system design for bibliographic systems have generally proved to be inadequate for management systems.

2.1.9 Communications

There is a general trend away from dedicated line and toward dial-up communications. Dedicated lines are commonly found in older systems with strong

central control (such as NASA, ERDA and the special military systems), although NLM is an example of such a system using dial-up. Dial-up service is prominant in agencies that are relatively new or in older systems which are expanding their capability. National communications networks such as ARPANET (now administered by the Defense Communications Agency) and the Tymshare, Inc. network have provided the dial-up linkage framework for such expansion at reduced per unit costs.

At the transmission/receipt ports, the trend is toward greater utilization of current lines through the use of packet switching technology.

2.1.10 Machine Aided Processing

Mechanization is being used to reduce human error and increase system effectiveness. Advances can be expected in creating machine readable input either as a by-product of primary publication or from optical character recognition (OCR) equipment. At least three agencies have a substantial interest in OCR devices: U.S. Air Force, Foreign Technology Division; NTIS and ARPA.

Machine-Aided-Indexing (MAI) or automatic indexing are technological extensions of machine readable input. MAI, machine readable input and advances in file design, when they are fully developed and technologically integrated, may eliminate indexes as we now know them in favor of internal relational data files and conversational human machine interaction.

2.1.11 Full Text Document Storage and Retrieval

The provision of document copy to end users in an acceptable form and time frame is the most unresolved technological problem in the information community. Little progress is evident in the development and application of facsimile transmission devices. For the foreseeable future, the community rather reluctantly is committed to image storage and mailing (microfilm and photocopy) of full text.

2.2 ORGANIZATIONAL STRUCTURES AND AFFILIATIONS

External to DDC, there is no unified, cohesive structure to the S&TI community, and this condition will persist for the target period. Ever-increasing

difficulties in obtaining operating funds give rise to a great deal of discussion about the need for information resource sharing at the national level. Still, the major information processing agencies are insular. There is no interdependency of these agencies at the operating level. Limited, ad hoc interagency agreements have resulted in linkages which must be regarded as an economic necessity more than as an attempt to unify the community into a national network.

The DoD RDT&E management information structure is a tiered, hierarchical reporting mechanism, and thus quite different in nature from the S&TI environment. In this survey, the Army and Air Force indicated a preference for an RDT&E management information transfer process independent of DDC. The Navy preferred to operate through DDC to develop a system adapted to its RDT&E management information requirements.

Key issues affecting the organization of the future S&TI interagency environment and DoD RDT&E management information structure include:

- Development and adoption of standards for information processing
- Public vs. private rights to information
- The functional roles of centralized and localized facilities and resources
- Coordination of the DoD RDT&E management information transfer process

These issues are discussed below in Sections 2.2.1 through 2.2.6.

2.2.1 Prospects for a National Information System

It is technologically feasible to develop a multidisciplinary national information system. NTIS is an embryonic version of such a system. However, there is concern that a single, monolithic national information system would be overstructured, would lack flexibility and would be too large to respond to user needs as these change.

A more logical alternative would be development of a national information "network." In recognition of the present diverse structure of the information community, development of such a network would entail:

1. Adoption of standards for design and processing to allow logical integration and intersystem compatibility

2. Formal interaction with resource sharing (e.g., ARPANET and common data bases) and system failure back-up provided by network members

2.2.2 Information Processing Standards

The major information agencies acknowledge the universal value of standardization. But no real support is found for compromising existing conventions without significant local advantage.

The library field has had success in standardization of records with the establishment of MARC record formats for cataloging data. This is probably a result of the late development of automation in libraries and a minimum of diversity in library operations. The information storage and retrieval field, which has exhibited rapid growth and wide diversity in design and operations has made little progress in the development and adoption of standards. The benefits to be derived from development and adoption of universal standards may be an inducement to information system designers, but there is no evidence of such a trend.

2.2.3 Public Versus Private Rights to Information

The emergence of a viable information industry and the issue of information as a public good raises serious concerns over property rights to systems software and information files. Many developments in hardware and software have been joint efforts of Federal agencies and commercial firms and/or not-for-profit institutes. Unanswered questions about the Government's role versus the private sector's rights hinder cooperation among members of the information industry. While this issue is unresolved, it will reinforce a natural tendency to insular operations - especially in the large, mission oriented information centers which DDC is most likely to find potentially useful as partners in a cooperative interagency structure.

2.2.4 Role of Local Facilities

Cost considerations and loss of system effectiveness in serving end users are likely to favor local outlets for information for the short and mid-

term represented in current plans. The large central information facilities with automated information retrieval developed principally in the 1960's have had poor results in dealing directly with scientific and technical information users at many remote locations. The majority opinion of those surveyed is that local facilities staffed by personnel trained in information retrieval techniques can provide end users with a higher quality of service than can a large, centralized facility.

2.2.5 Information Analysis Centers (IAC)

Factual information of the type provided by IAC's must be made an integral part of the formal S&TI information transfer process. The military research directorates, NBS and the agencies with national priority missions (NOAA, ERDA, etc.) are specifically interested in linking IAC resources to bibliographic based automated retrieval systems. In some instances, IAC files will be loaded on the central system for widespread access. In other instances, a list of referrals to relevant IAC's will be preferred. Programs to achieve formal linkages are in the planning stages in the national mission-oriented agencies, but it is too early to predict the structural interagency patterns that are likely to develop.

DDC could add a new dimension to its S&TI information program by serving as the central point of contact in DoD for IAC/fact data. IAC files of multidiscipline interests or review files are created and maintained with the cooperation of DoD IAC's should be available from a central source.

2.2.6 RDT&E Management Information Structure

DoD has a parochial RDT&E management information structure. The Army, Navy and Air Force each maintains a unique profile. The Army is in a development mode and revamping its MIS making MARDIS a decentralized, locally controlled system. The Navy has opted to discontinue its MIS in favor of a centralized DDC operation which will serve Navy RDT&E managers. The Air Force appears to be satisfied with the MASIS system. All three Military RDT&E management information systems interface with the Director of Defense Research and Engineering (DDR&E) while serving the needs of their own program managers and work unit supervisors.

It appears that there is sufficient similarity in the objectives of the three independent military systems to consider central coordination at DDC. Two significant problems will have to be faced.

1. DDC's present management oriented information systems are inadequate to provide services similar to those of MARDIS and MASIS.

2. Centralization will be traumatic to the agencies affected and will require a highly coordinated development program that includes all parties in setting system parameters and design objectives.

2.3 ECONOMICS AND MARKETING

The economic system of information transfer processes is artificial and will remain so for the foreseeable future because there is no common econometric value for information. The interagency survey indicated that a pragmatic measure is not forthcoming from the information processing community. In this environment, a marketing effort aimed at demonstrating the empirical usefulness of information products and services becomes an essential function of an information agency.

Key conclusions relating to DDC include:

- Programs previously hampered by high cost will become affordable
- Programs requiring new revenues will have to be rigorously justified
- Effective marketing efforts are needed to exploit the full potential of DDC's information programs

These issues are discussed in the following sections 2.3.1 through 2.3.4.

2.3.1 Utility of Cost and Benefit Measures

Cost data provided by the agencies in this survey are not a reliable means of a cost comparison among agencies nor can they be used to extrapolate the experience of one agency to another. Development and indirect operating costs are not generally reflected. Thus, it would be misleading to use published costs as a basis for DDC long-range decision making.

Even if total costs were known, there is no common measure of the benefit information produces in terms of industrial or governmental productivity or effectiveness. Information programs that are "cost/effective" for one agency may not be for another. The lack of an objective econometric value of information will prohibit DDC from demonstrating the direct impact of its services and products to both management and users. Consequently, subjective values prevail.

2.3.2 Decreasing Technology Costs and Budgetary Implications

Direct costs for automated technology are on a downward trend. Computer costs, in particular, are decreasing on a per unit of use basis. The prognosis is favorable for continuing unit cost reductions through the decade 1978 to 1988. Improvements in cost performance have resulted from cutbacks in human input requirements, use of special purpose mini-computers to do tasks formerly done on general purpose machines, better overall utilization in distributed networks, lower data storage costs and lower per unit communications costs. Communications costs, for example, are expected to continue downward (currently 1¢/second connect time to .0001¢/second by 1980.)

2.3.3 Cost Recovery Charges

The surveyed agencies generally do not intend to recover costs of information storage and retrieval. In some cases, however, budget constraints have resulted in efforts to recover nominal costs or incremental costs from customers more as a demonstration of accountability than pure economic concern.

Two exceptions are NTIS and INFOCEN. NTIS is obligated by law to recover the costs of operation. However, it is not clear which costs are included in NTIS pricing policy. INFOCEN is wholely funded by its customers and operated by the U.S. Air Force as an unfunded operating system.

2.3.4 Marketing Efforts

No agency in this survey has a marketing program that can be an appropriate model for DDC. Of the fourteen agencies surveyed, only two had an active marketing effort: NTIS and NASA. NTIS is a marketing agent for unclassified unlimited Federal Government technical information, but its objectives

are unlike those of the national mission-oriented agencies. NASA's marketing program could be of interest to DDC because it is aimed at increasing the user's effectiveness as part of the NASA information transfer process. But this program has been too recently implemented to be evaluated.

Brochures, training programs and other user awareness efforts employed by all agencies surveyed are minimal marketing programs, which have had minimal success.

2.4 SCOPE OF SERVICES

DDC needs to broaden its scope of services and satisfy a wider range of DoD information needs. Related issues that surfaced in the interagency survey include:

A. RDT&E Management Information Services

- RDT&E management information must be fundamentally different from current DDC services
- Information needs differ at various management levels

B. S&TI Services

- Specialized data bases are needed for comprehensive S&TI
- National information agencies in the survey provide comprehensive, multidiscipline S&TI
- Document delivery problems have no foreseeable solution

These issues are discussed in the following sections 2.4.1 through 2.4.5.

2.4.1 RDT&E Management Information Services

Traditional bibliographic information storage and retrieval techniques are insufficient for satisfaction of future RDT&E management information requirements. New concepts in information transfer are required to support RDT&E managers. Fact retrieval and exception reporting to support management control functions are key elements of management information systems. The military

RDT&E management information systems perform these functions. Responses of S&TI systems, which serve as pointers to information, are of insignificant value in the RDT&E management community.

A successful RDT&E MIS will:

1. Support management control functions (requires accurate and reliable data collection)

2. Support RDT&E program planners (requires data assimilation and inferential decision analysis models)

3. Support top level administrators, including non R&D administrators on an ad hoc basis (requires rapid access to volume data in a variety of files not necessarily in a single operating system)

Some progress has been made in each area, but none is well established in the current state-of-the-art.

2.4.2 Specialized S&TI Data Bases

There is a trend toward the development of specialized data bases of scientific information, consisting of factual data in computer storage, rather than citations to documents containing facts. Files such as the NBS National Standard Reference Data Files and unique files compiled by the IAC's are characteristic of the special data bases that are emerging. Among the first of these fact files are the GIDEP (Government/Industry Data Exchange Program) data banks, a nuclear research data bank, and an energy data file. A refined environmental research data bank will probably emerge from NOAA/NASA. There is insufficient evidence to forecast the relative effectiveness of special files that will evolve. It is expected that technical data files will develop as independent scattered files that become known within a relevant field. Mergers will be a first step toward central management, properly coordinated in more than one network. Finally, standards will be established for standard data reporting.

2.4.3 Comprehensive S&TI Services

DDC's sole reliance on DoD technical reports for its information base is at variance with the policies of most of the agencies surveyed. A trend to

broaden the S&TI coverage of all key information agencies has been underway in recent years because R&D projects and priorities are not static and R&D is becoming more multidisciplinary. Demands for comprehensive coverage of many disciplines and all forms of published information are reported by the agencies surveyed. This has resulted in projects (notably at ERDA) to incorporate data bases from many sources into existing systems or to contract for commercial services with a broad bank of scientific data bases.

2.4.4 Document Delivery

There is no foreseeable solution to the problems of providing full text of documents to remote locations in a form acceptable to users. Currently, the only practical alternatives include the use of extensive remote collections (e.g., libraries) or central microfilm and hard copy collections distributed by U.S. mail -- both are inadequate.

User dissatisfaction is expected to increase as information handling technology is improved and the time span between the completion of search and retrieval activity and document delivery widens.

Some optimism was indicated in the survey that eventually the problem will be resolved by total electronic storage and transmission of documents or partial documents.

SECTION III. ROLE OF DDC IN THE PROJECTED S&TI AND RDT&E MANAGEMENT INFORMATION COMMUNITY

In the previous Section, it was demonstrated that DDC operates in an environment composed of S&TI agencies external to DoD and, simultaneously, DDC operates within the RDT&E management information structure of DoD. In this Section, DDC's role in that environment is defined.

DDC's overall role in that environment is to:

1. Ensure that the resources of both DDC and external S&TI agencies are freely accessable to DoD and contractor scientists and engineers

2. Employ techniques to enhance the DoD scientific and management decision processes

3. Act as a leader in the development of improved technology for information transfer

4. Demonstrate accountability[1] for current and planned DDC products and services

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[1] Accountability means the management process by which DDC's programs are shown to be appropriate for effective and efficient management of DoD resources

Through fulfillment of this role, DDC will not only improve the S&TI and RDT&E management information transfer process within DoD, but it will also contribute to the advancement of the status of the information environment within which it operates.

In the remainder of this Section, recommendations regarding DDC's attainment of this role are discussed within the framework developed in the previous Section:

- Technology (Section 3.1)
- Organizational Interface (Section 3.2)
- Economics and Marketing (Section 3.3)
- Scope and Nature of Services (Section 3.4)

3.1 TECHNOLOGY

Section 2.1.1 of this report concluded that information technology is not being fully exploited. In recognition of this fact, it is recommended that DDC should take advantage of state-of-the-art technology to bring both S&TI and RDT&E management information services and products into more direct contact with DoD decision-making processes. This will involve the following successive steps:

1. Development of a better understanding of RDT&E and S&TI decision processes
2. Development of innovative services to contribute to enhancing those decision processes, using state-of-the-art technology
3. Clarification of inadequacies in the state-of-the-art so that vendors and systems designers can jointly contribute to development of improvements
4. Announcement of DDC plans and programs to upgrade information technology so that other agencies can benefit from DDC leadership and cooperate in solving problems of mutual interest

Recommendations for the development and utilization of technology by DDC are presented in the following subsections: 3.1.1 through 3.1.5.

3.1.1 DDC's Response to Technological Influence

DDC's technology development program for the target period needs to be sensitive to three primary influences:

- Progress in Hardware Technology

  Central and mini processors, intelligent terminals, work input devices and stand alone information equipment (such as microfilm equipment) will continue to improve, solving shortcomings readily observable in today's technology.

- "Momentum" in Information Technology

  The magnitude of the information industry has become a constraining influence on fundamental system design changes. Basic changes that render current investments in data processing obsolete are not likely to become operational without resistence. Thus, most new information technology developments can be expected to have a basic compatibility with present technology, particularly within the target period of this study (1978-1988).

- Lag Time Between Development and Applications of Technology

  Despite dramatic progress in hardware development, most applications have tended to be efficient replacements for calculators, accounting machines, office equipment and manual procedures. Although the information retrieval process is more thorough and efficient now than it was as a manual effort, the information habits of scientists, engineers and managers have not changed fundamentally as a result of technology advances.

To cope with these influences, DDC's policy in regard to technology should reflect the following priorities:

1. Emphasis should be given to innovative systems designed to aid scientists and managers in their decision processes - not merely to add to the available tools for accessing potentially useful data. DDC must provide answers - not just citations. Yet, this type of innovation tends to be most frequently lacking due to the third influence described above.

2. The current state-of-the-art should be exploited fully. Where technological performance or cost deficiencies are encountered, they should be defined clearly for the benefit of vendors. Agencies with similar problems may then be willing to cooperate in efforts to advance the state-of-the-art. Operating agencies, or a research agency such as ARPA, may have mutual interests in a DDC problem. Hardware, software, communications and information handling technology are addressed equally in this recommendation.

3. As a leader in the field, DDC should commit itself to applications of new technology which may be initially costly, but which can demonstrate economic performance through high volume use (possibly involving other agencies or commercial firms) to amortize the development costs.

3.1.2 Computer Technology

A recurring theme encountered in the interagency survey was that improvements in:

- file design
- development of special purpose peripheral equipment for input and output, and
- software development

are feasible and if they could be exploited, significant progress could be made toward reducing the complexity of the current man-machine interface. Consequently, DDC's computer development efforts should concentrate upon these areas.

In addition, DDC, as a major consumer of computer components, should exert its influence upon vendors to encourage developments in all three of these areas. To do so will require that DDC should define its technological objectives and performance requirements clearly. Whenever feasible (and where not in conflict with primary DDC objectives), these should reflect the requirements of the interagency information community.

3.1.3 Communications

The field of data communications is an area certain to experience enormous growth from now through the 1980's. Two factors will influence the expansion of DDC's on-line system:

1. Switching
2. Decentralized Computing

3.1.3.1 Switching

In the 1978 to 1988 time frame, a data communications network, analogous to current telephone networks, will allow scientists to work on related problems in various locations nationwide. Depending on the information needs of a given moment, diverse system components (software, data bases, etc.) will

be brought to bear on a problem according to respective capabilities. A common communications network linking major information agencies may be realized.

DDC, as a participant in this network, will act as both a user and a resource, providing access to its information stores as well as access those of others as needed. Through DDC, members of the Defense RDT&E community will gain access to information resident in DDC and external data banks. Likewise, users of other information centers will gain access to DDC resources through this networking and switching concept.

Classified information presents some special problems to the fulfillment of DDC's role as a resource supplier in the network. Classified and limited distribution of the DDC files, and possibly some special technical capabilities, will have to be withheld from common resource sharing situations.

3.1.3.2 Decentralized Computing

The networking and switching between DDC and information agencies will be facilitated by the new and emerging modular concepts in "computer to computer" communications systems. DDC's present on-line system requires time sharing of a large central processor. However, the trend appears to be toward using configured networks of special processing components, each contributing various modules of computing power. If DDC is to act as a member of such a network, it must consider the potential usefulness of stand alone and special purpose computing components.

Special processors for channel and device control, communications line control (such as the Interface Message Processors of the ARPANET), remote multiplexing system monitoring and similar functions are indicative of the trend toward decentralized computing. Intelligent terminals and satellite processors permit routine tasks such as input processing to be performed locally so that access to a central computer facility is required only if large files must be addressed.

For S&TI users, local modules could be used to help structure a search strategy involving several data bases or to access the files of one or more Information Analysis Centers. The strategy could be developed prior to entering the interagency communications network. A small, desk top device

similar to a calculator is currently being marketed as an on-line terminal. It is quite feasible that such a device will be available as an intelligent terminal to perform such functions in the decade 1978-1988.

3.1.4 Document Handling Technology

Agencies in the survey anticipate gradual, but increasing dependence on machine processing, encompassing all aspects of document generation, announcement, surrogation and eventually, distribution. DDC's present research in machine aided indexing, automatic indexing and natural language processing should put it in a position to achieve significant improvements in the efficiency of its surrogation processes. The major obstacle to complete machine processing is a means of generating a complete machine readable record for all textual material automatically at some point in the publication or surrogation chain. This level of control currently exists for secondary publications, but is lacking for primary publications. Before 1988, machine readable forms of primary publications should be available.

Use of machine readable files for electronic distribution of full text materials is not imminent. Nevertheless, full text electronic document delivery to DoD scientists and contractors is a reasonable objective for DDC, despite the fact that it is not practical with today's technology.

3.1.5 "Fact" Handling

DDC must develop capabilities to store and retrieve facts. Concepts and data (facts) are information elements that a scientist or manager can make decisions about or take action on. Citations sometimes contain facts, but usually citations indicate possible sources for facts. Fact files should be generated as a product of the publication cycle or as a product of surrogation.

John O'Connor provides a lucid example of the fact retrieval vs. bibliographic retrieval concept in the form of retrieval of "passages" from text:

> "When a physician asks, 'What drugs have been effective in preventing venous thrombosis?', he should receive not merely a reference:

> The use of low molecular weight dextran and serum albuminin as plasma expanders in extracorporeal circulation, D.M. Long et al. Surgery 50, 12-28, 1961.

but also get from the referenced document a passage which answers his question:

> Rheomacrodex prevented or minimized intravascular aggregation and thrombosis during extracorporeal circulation as judged by direct observation of the conjunctival vasculature.

Such passage retrieval will be the next major revolution in document retrieval."[1]

Fact retrieval files offer an opportunity to greatly expand the usefulness of DDC services. The major obstacle to their establishment is the definition of which facts are useful to scientists, engineers and managers for decision making. The role of DDC in this effort is to explore the use of fact systems and decision making in an effort to establish some fundamental principles to guide further development of fact files for use by the Defense RDT&E community.

3.2 ORGANIZATIONAL INTERFACE

DDC plays an organizational role with an interface internal to DoD and also an external interface with the information community at large. The DoD RDT&E program has a hierarchical management structure involving the Military services as separate entities and a centralized structure represented by DDR&E. The role of DDC within the DoD RDT&E management structure is that of information system designer and RDT&E management information provider. DDC should design and implement a comprehensive, integrated RDT&E management information system. This system may function either as a centralized, DDC-based system or a decentralized operation within the Military services and coordinated by DDC.

The external interface of DDC's organizational role places it as an intermediary between DoD S&TI users and non-DoD information resources (including other Federal agencies, commercial and academic information resources). DDC

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[1] O'Connor, John. Passage retrieval services for scientists. In: Information Revolution. Proceedings of the 38th Annual Meeting of the American Society for Information Science, Boston, Massachusetts, October 26-30, 1975. Volume 12. p. 80.

should begin to plan to make external S&TI information resources more fully accessible to DDC users. This will require DDC to interact with external S&TI organizations capable of augmenting DDC's internal information resources.

Recommendations for achieving an effective interorganizational interface are presented in the following subsections 3.2.1 through 3.2.3.

3.2.1 Exchange of S&TI Between DDC and External Agencies

To assure that comprehensive access to all S&TI relevant to DoD research is available to DDC users with a minimum start up time and minimal additional personnel requirements, DDC should begin to utilize available information products and the resources of existing organizations - especially other data bases. Such a program has already been undertaken by ERDA. It involves:

- First, on a pilot basis, examination of the desirability of using existing on-line services (e.g., SDC and Lockheed) to fill the need for supplementary data bases.
- Next, development of a common DDC information format (based on or the same as currently used) and negotiation with information producers (for profit, not-for-profit and other federal agencies) to provide input in this format, to an expanded data base. Where feasible, the DDC data bases or subsets should be used to barter for other agency's files in such formal agreements.
- Finally, development of a screening procedure to avoid duplicate entries and increase the relevance of the file for DoD use.

By making DoD information products available to NASA and NTIS (among others), DDC has been one of the mainstays of the information processing community. This policy should continue so long as it does not interfere with the primary mission of DDC to serve DoD personnel and contractors, and so long as the cost to DDC does not exceed the requirements for accountability.

3.2.2 Role of Local Library Facilities

DDC efforts to deliver its information effectively should emphasize the role of local libraries and information resources. Libraries operating within organizations served by DDC are points of direct interface between DDC and its users. They are often in a position to act as interpreters of the users' needs in terms of DDC's capabilities. Conversely, they can aid the user in

understanding the nature of DDC response to a query.

3.2.3 RDT&E Management Information Service

DoD's RDT&E management structure involves all managers from the research work unit level to DDR&E program officers. Obviously, the information needs of managers with day to day responsibility and those with long range planning responsibility are different. The closer the manager is to the work unit, the greater the need for control information. Descriptive information (e.g., DD 1498 forms) is indicative, but it is inadequate for management control functions.

The emergence of RDT&E management information programs independently developed for use by the Army (MARDIS) and the Air Force (MASIS) should be subjected to careful review. DoD accountability may be better served if a centralized program of management control information were to be developed.

It is feasible to initiate a central RDT&E management information service for the military branches at DDC. However, if this service is to meet the needs of managers at all levels, the current DDC RDT&E management information system, represented by the Work Unit Information System, the R&D Program Planning, and Independent Research and Development Data Bases, will have to be significantly improved. As a first step, a comprehensive systems analysis and requirements study should be undertaken to sharpen the focus of the DoD RDT&E management information system. DDC and representatives of the military services will have to become actively involved at this stage. This is particularly important, since all service branches are not in agreement that a central system could meet their specific needs. Results of this study should be presented to DDR&E in the form of recommendations for development of a DoD-wide RDT&E management information system which will adequately serve the needs of all levels of management.

DDC's role in the development of a significantly improved RDT&E MIS should be one of willing partnership with the military services. Local controls will be required over every stage of the systematized reporting program. DDC will need to carefully coordinate these activities.

The Navy commitment to rely on DDC for its management information support affords an excellent opportunity for a pilot development program. However, it is strongly recommended that such a pilot program be coordinated with all the military services that will eventually be affected.

3.3 ECONOMICS AND MARKETING

"Economics" of information has come to refer only to the costs of information generation, processing and dissemination. As pointed out in Section 2.3.1, there has been no development of value or measurable benefits of information needed to make economic judgements.

"Marketing" of information has come to refer to the activities of announcement and distribution. Outside the information environment, marketing (of products and services) is associated with activities intended to focus or create demand.

DDC's role relative to economics and marketing issues in the information community is viewed within the context defined above.

DDC's economic role is to present DoD parent management with clear cost and technical alternatives in information programs. At this time, the cost of providing information is the only direct economic measure available, so DDC must be able to provide an estimate of benefit value for various levels of service in some subjective measure that can indicate the intrinsic value of information to DDC users.

Users need to be educated regarding DDC products and services and DDC must be educated regarding user needs. DDC's marketing role is educational. A program is needed to show how DDC services help DoD's technical staff, its contractors, and RDT&E managers do their jobs better and more efficiently. This must be done by providing examples, rather than general information.

Obtaining user feedback is part of DDC's marketing role. As a marketing function separate from a technical function, product development should be receptive to new ideas presented by users. Users (including organizational users) who are heeded become strong information service supporters.

Recommendations for achieving the projected economic and marketing roles are presented in the following subsections 3.3.1 through 3.3.5.

3.3.1 Economic Value System for Decision Making

There is a general consensus among those surveyed that it is desirable to use conventional economic value analyses as a basis upon which to design new and improved information handling systems. But no value measure for information is currently available to permit normal management decisions to take shape under properly balanced influences of cost, timliness, volume and selectivity. As a result, DDC, will have to assess the desirability of each proposed information development program on an individual basis for the foreseeable future, using cost and subjective judgement as the best available criteria. User input will provide valuable assistance in making such decisions.

3.3.2 Cost Accounting for Measurement of Use

Since benefits cannot yet be measured, and costs become the predominant economic influence in the information structure projected through 1988, DDC must consider new approaches to administering expenses and acquiring revenue. New revenue will certainly be required to fund programs that become desirable as technology costs decrease.

Despite the fact that all DDC operating funds are provided by the Federal Government, accountability in administering information programs requires that direct relationships be established between revenue and use. Consequently, reliable cost accounting procedures are needed to demonstrate proportionate DDC use.

The establishment of a cost accounting system to measure proportionate use may entail increased application of user charges and formal interagency fund transfers for agencies which use DDC information products. While such procedures must be regarded as burdensome, the prospect of DDC's not being able to secure new revenues because of an inability to demonstrate a "real" demand for its services is even more bleak. Competition among Federal agencies and within DoD for funds shows no promise of easing. As demands for consolidation of services grow, as they are likely to do, the agencies with an accountable administrative structure will be in the strongest position to secure new revenues for growth.

3.3.3 Marketing Interface

DDC must assume the prime responsibility to ensure that members of the RDT&E community are making effective use of DDC information resources by assuming an aggressive marketing role. Marketing efforts will help users get the most from the various systems by continuously reminding them what is available and by providing examples of novel uses of information products and services to stimulate user imagination. Above all, DDC marketing efforts need to be simple and direct.

The marketing effort need not be limited to DDC products alone. There are several information systems with files that are potentially useful to DoD researchers, including the NBS National Standard Reference Data System, NOAA, NASA, and ERDA files. If DoD views DDC's marketing role as one to ensure the most effective use of information to conserve research effort, it would realize that it would be well served by such a program.

3.3.4 Marketing an RDT&E Management Information System

In Section 3.2.2, the development of a new RDT&E management information system was recommended.

A consolidated management information system which assumes the functions now performed by separate military services will cause significant changes. To individuals and organizations affected, these changes may be overwhelming. Antagonism is to be expected. To provide for enthusiastic cooperation, it must be emphasized that the severity of the changes can best be reduced by the cooperation of all parties concerned. This is a marketing role which DDC will have to assume as the agency charged with implementing a unified RDT&E management information system. Any proposed RDT&E Management Information System must be characterized within a framework that is simple and direct in essential details.

The time to plan such a marketing effort is now, as opposing positions are beginning to develop within the military branches. The greatest danger is that early and strong opposition to a consolidated system could result in the implementation of a token system that is ineffective.

3.3.5 Responsiveness to Users

DDC's user liaison office should actively explore the need for new products, beginning with large institutional customers. Such an arrangement would provide institutional users and DDC system designers with invaluable insight to each other's problems, limitations and needs. A continuing feedback system should be developed to ensure that DDC is constantly aware of changing user requirements. The ability to respond to these requirements is the responsibility of the DDC Directorate of Development.

3.4 SCOPE AND NATURE OF SERVICES

DDC has a twofold role with regard to its scope of services.

1. DDC should broaden the context of its present services to respond to a wider spectrum of DoD technical and management information needs. To accomplish this, DDC must find means of incorporating open literature, fact retrieval services, and specialized information resources into its scope of services.

2. DDC must work toward the development of fact retrieval systems, and ultimately toward decision making services for both S&TI and RDT&E information services.

Recommendations to support the projected service role are presented in the following subsections 3.4.1 and 3.4.2.

3.4.1 S&TI Services

In current and future S&TI services, the opportunity for DDC to achieve a new, higher level of usefulness to DoD offers two challenges:

1. conventional, technical report-based programs are insufficient to satisfy a full range of scientific and technical questions; at best, they provide partial answers or help to clarify the scope of a technical problem

2. technical information storage and retrieval systems, in general, and DDC's systems are no exception, are too complex for the average user to utilize them in order to receive maximum benefit

It is necessary for S&TI services of the future to provide more than library-like functions. Utilizing the full potential of automation , DDC must

move toward a comprehensive integrated system concept. The increasing size of the Defense budget, the expanding depth and breadth of technical knowledge, the growth in the number of users, and the diversity of interests from individual to individual cannot be served from local, homogeneous collections. S&TI services will have to be capable of providing factual answers, and logical models of "invisible colleges"[1] inferred from conventional data bases. The first element and embryonic parts of the latter two now exist in independent fashion but little progress has been made toward their interaction.

The second challenge is to deal with the human factor in information systems and to make system complexities transparent to the user. Tasks to achieve progress toward this end include:

1. Use of conversational modes of communication for interaction with information systems

2. Simplified and standardized protocols and language for calling files and system modules

3. On-line system monitors with analysis features to aid the user in understanding the consequence of various search strategies

Several industries have been able to achieve this blend of technological sophistication and end use simplicity, notably the telephone industry and automobile industry. From the perspective of time-phased development requirements, it must be recognized that the telephone and automobile have been under active development throughout the entire 20th century. Information technology is barely two decades old, and it is more complex than the technologies associated with the telephone and automobile industries.

3.4.1.1 Comprehensive Coverage

DDC's coverage of S&TI must be expanded beyond DoD technical reports. DDC's mission assigns it with responsibility for assuring DoD scientists and engineers access to all relevant S&TI. This recommendation is made for all scientific and technical disciplines covered by DoD RDT&E interests. One possible exception is the medical research group (served directly by NLM).

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[1] Invisible colleges are de facto groups of scientists with mutual interest and comprehensive knowledge on very specific scientific and technical disciplines or problems.

But a potential problem exists in this regard. Unresolved questions over the public versus private rights to information (section 2.2.2) threaten to restrict DoD's access to important scientific and technical data bases. DDC, as the DoD information agency, must be prepared to resolve this problem by working out suitable, non-restrictive contractual arrangements with suppliers of technical literature data bases.

3.4.2 RDT&E Management Information Services (MIS)

Current DDC data bases designed to support RDT&E managers serve a memory role, i.e., they store descriptive information regarding plans and work in progress. This information is supplementary and not always useful for making management decisions involving a choice of alternative programs and actions.

DDC must plan and implement an effective RDT&E MIS which will help DoD RDT&E managers to assess their options. As the designer agency, DDC must be certain that its MIS represents real decision making potential for program control and planning.

3.4.2.1 Level of RDT&E Management Support

The type and level of managers to be supported by the RDT&E management information system must be carefully selected. It would be overly ambitious to attempt to serve managers at all levels from the DDR&E to the work unit level with one system at one time. Limited objectives should be met first to establish a successful base on which to build. The option is to serve managers at one end of the spectrum or the other first and then build from there.

If the work unit level managers are served first, conflicts in individual interests among the military services will have to be resolved before significant progress in building a comprehensive RDT&E MIS can be made. If long range program managers at the DDR&E level are to be the first management level served, the present systems could be used as a starting point, and support for the system could be generated at the highest level. However, cooperation would be required from those with little or no self-interest in the system's success.

Determination of the approach most likely to achieve initial success will have to be made according to an internal assessment of the DoD management environment.

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APPENDIX A.

INTERAGENCY SURVEY FINDINGS

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1.0 REASON FOR INCLUSION

The Defense Advanced Research Projects Agency (ARPA) is a unique agency with a broad charter to take on research tasks which are not possible for other agencies because of high failure risk, or which are too general in scope to be assigned to one agency. ARPA is designed to emphasize three functions: maintenance of leadership in forefront areas of technology; maintenance of the U.S. strategic deterrent; and increase the efficiency of the DoD. In all three functions, particularly the first and third, ARPA's Information Processing Techniques Office is addressing the technological areas which are the most challenging to contemporary information science. ARPA's role is to assure that research to support the development of specialized information processing equipment and techniques will be accomplished in time to meet future needs.

Success at ARPA will directly affect the timing of technological innovations known to be needed by today's scientists and information processing managers.

2.0 CURRENT PROFILE

2.1 Technology

ARPA has no in-house computer facilities. A large number of organizations, both military and civilian, perform research tasks under contract. Approximately 850 research contracts are funded each year.

2.2 Organizational Structures and Affiliations

ARPA interacts broadly within DoD to formulate its research program. Within the Office of the Secretary of Defense (OSD), the major organizational relationship is with the Director, Defense Research and Engineering (DDR&E). Other input is provided by the Offices of Assistant Secretaries for International Security Affairs, Manpower and Reserve Affairs, Intelligence, Program Analysis and Evaluation; the Director of Telecommunications and Command and Control Systems, and the Assistant to the Secretary of Defense for Atomic Energy.

Four Defense agencies provide information and guidance for some ARPA programs and also some contract monitoring assistance: the Defense Intelligence Agency, Defense Nuclear Agency, Defense Communications Agency, and Defense Security Assistance Agency.

Sixty nine Defense organizations, mainly in the three Services, and eight non-Defense organizations administer ARPA contracts. The contracting organizations are selected on the basis of their in-house technical capabilities as well as with a view to eventual program transfer.

By continuous involvement from the outset, the organizations learn the technology of the program, provide service application viewpoints, and incorporate results from the ARPA research into their own R&D and operational activities. Then, when the program is concluded they are prepared to take over the fiscal and technical responsibilities if appropriate.

ARPA's goal is to initiate programs, establish their feasibility and transfer them to service organizations at the earliest possible time. Not every program is feasible to transfer. In emerging technologies within ARPA's scope there are impasses. Such negative results are also important contributions to the field because they demonstrate non-feasibility and aid the planning programs of the service organizations.

2.3 Economics and Marketing

ARPA was established to provide an organization which is able to explore high pay-off, controversial projects with limited chance for success without

conflicting with funds for vital operating expenses. ARPA projects are funded within a context of limited expenditures. In FY 1975, the Information Processing Techniques Office provided over $40 million to support basic research in information techniques, distributed information systems, and advanced command, control and communications technology. Projects run three to six years and then are transferred to operating agencies or are discontinued.

2.4 Scope of Services

The Information Processing Techniques Offices administers the programs in information science. Spin off technology from other programs may also benefit the information field.

The Office administers the Information Processing Techniques project in basic computer research and two applied projects: distributed information systems, and advanced command, control and communications technology.

The Information Processing Techniques subprojects include: automatic programming, picture processing (aimed at developing narrow-band image processing techniques and restoration of degraded images), and intelligent systems (theory development for solution of complex problems involving planning, generalization, learning and interpretation of sensory information, and speech understanding -- developing prototype systems to respond to spoken, connected speech.

The Distributed Information Systems Project is developmental. Subprojects include: parallel processing applications (development of effective user access to ARPA's ILLIAC-IV computer, a unique parallel processing computer architecture in which several parts of a computation are executed simultaneously), distributed networks, Secure Systems (design of tools to guarantee the security of multi-user computer systems), Secure Voice Compression Techniques, and Management Systems Technology.

Development programs for cost and time savings have produced "packet switching" technology. This program, carried out by the Advanced Command, Control and Communications Technology Office has three subcomponents: satellite packet technology, ground radio packet technology (radio bands), and integrated command and control systems security.

All projects are in various stages of progress, and certain elements have been transferred to the operating services.

3.0 CONCLUSIONS

The results of ARPA funded projects can have fundamental influence on the technological profile of the information community in 1988. Projects such as the ARPA computer network (ARPANET) and the development of special large scale information computers have a reasonably good chance for successful development with ARPA support.

The prospects of projects that are directly related to key issues in the general information processing community are summarized as follows:

- very large data base (e.g., 10^{15} bytes) handling techniques should be available in the 1980's for semi-conductor type main memory computers
- machines to interpret vocabulary expressed in continuous speech are being developed (1,000 word vocabulary interpreters are now available)
- artificial intelligence is seen as the area where the next major breakthroughs will occur
- conceptual breakthroughs in less formal data structuring are being investigated. Interest is to design systems to permit data input at a local (bench) level and systematically accumulate it and feed data systems in a hierarchical line
- data recording and files of verified, or qualified values are being investigated
- security of transfer systems will require end to end incryption programs. No success is seen at this point in time, and none will be ready for implementation by 1988

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1.0 REASON FOR INCLUSION

ERDA's information program is one of the oldest and most extensive Federal documentation efforts. It has pioneered R&D in information technology within its atomic energy component. Like DDC's technical information program, ERDA's national energy information program has a national scope. Its information program serves an RDT&E community with defense as well as civilian links. It operates a comprehensive, sophisticated mechanized information system with on-line computer capacity. The nature of its mission and the advanced stage of development of its information program indicates a high potential for ERDA/DDC interaction.

2.0 CURRENT PROFILE

2.1 Technology

ERDA's main technical facility is located at the former Atomic Energy Commission (AEC) complex at Oak Ridge, Tennessee. Input control for Nuclear Science Abstracts (NSA) relies on a DEC on-line duplexed computer system; two PDP-10 processors with 128K core memory, with I/O bus switches; six magnetic tape drives; two disk drive systems containing 420K characters of on-line storage; seven on-line keyboard teleprinting terminals for programming and input of administrative control data; two graphic systems including two PDP-8's, each with 16 core and disk driven CRT graphic terminals for text input. Index processing and preparation of output tapes is done under contract by the Computer Sciences Division,

Union Carbide Corporation, Nuclear Division (UCND). UCND also operates ERDA/RECON an on-line interactive information retrieval system. At the beginning of 1975 there were 24 terminals on-line 50 hours per week.

ERDA/RECON started as an AEC dedicated system but it has proved to be too limited to meet its expanding commitments, especially to provide adequate service to the nonnuclear research centers.

The Technical Information Center at Oak Ridge is ERDA's documentation center, and it collects, catalogs, indexes, abstracts, announces, and distributes information on energy. It uses two MTST-Model 4, seven MTST-Model 5, and five MTSC for composition of publications.

Document holdings include journals, U.S. Atomic Energy Commission engineering materials, books, monographs and over 400,000 technical reports from ERDA, DoD and other government agencies. The principle index is Nuclear Science Abstracts, a semi-monthly publication in hard copy coupled with on-line access. Four indexes are provided: corporate author, personal author, report number, and a controlled language subject index. Full text holdings consist of 780,000 hard copy documents (and microfiche of recently published documents) of reports announced in NSA. General full text distribution is handled by NTIS. Classified documents are distributed by Oak Ridge and local facilities.

2.2 Organizational Structures and Affiliations

The Energy Reorganization Act of 1974 consolidated the Federal energy effort of four agencies (the largest was AEC) into the executive agency, ERDA. Shortly thereafter, the technical information function of the AEC was reorganized and a study of the problem of providing abstracting, indexing and documentation support to the broader program of the nonnuclear energy research effort was undertaken. The study concluded that 90% of the total energy field was covered by one or more of existing services. A commitment was made to create a comprehensive bibliographic data base covering the entire field of energy.

Policy assumptions which guide the ERDA program include:

1. to develop a mission oriented system primarily designed to meet the R&D needs of ERDA

2. to build the system from information existing in the U.S. or abroad, acquiring it by purchase and/or exchange and to minimize the use of direct Government resources

3. not to publish an abstract journal with broad coverage of the energy field

4. to seek the assistance, as appropriate, of the private sector in adapting information materials to ERDA needs.

It has been determined that the expanded data base will be compiled in machine readable form and used in a variety of ways. Bibliographic information in the common ERDA data base will be made available to the private sector for further use primarily through the sale of magnetic tapes. Preliminary thinking is that ERDA should limit production efforts to producing an in-house publication for ERDA reports only. Any abstract journal or similar publication will have to come from the private sector. Specialized publications for ERDA programs will be issued as required. Bibliographies, for example, will be drawn from the data base and published jointly with the Federal Energy Administration and the National Science Foundation. An example of such a publication is Energy Abstracts for Policy Analysis, which is a small abstract journal issued by the Energy Information Analysis Center at the Holifield National Laboratory for FEA and NSF.

Cooperative arrangements with the International Atomic Energy Agency's (IAEA) International Nuclear Information System to include abstracts in its publication Atomindex may also result in the discontinuance of NSA within two years.

To create its expanded data base, ERDA is relying heavily on acquiring materials through purchase, contract and exchange. The file is machine readable and in various stages of completion. It consists of three conceptual levels. Level 1 consists of all unfiltered files which contain information on basic research support, energy conservation, engineering, coal, oil and synthetic fuels, nuclear fission power, fusion, energy storage and transmission, solar and geothermal energy,

and environmental aspects of energy. Government and private data files go into Level 1, e.g., Engineering Index, Physics Abstracts and Chemical Abstracts (with restrictions).

Level 2 is created as a result of negotiated agreements with the data base suppliers. By such agreements, ERDA is able to create subsets of the unfiltered file for special ERDA purposes. Level 2 has begun with a compilation of data bases on coal gasification, coal liquefacation, coal desulfurization, solar and geothermal energy R&D, superconductivity, and oil shale.

Level 3 consists of a file which is internally consistent, uniformly structured and formatted. While ERDA will not use it to produce an energy abstract journal, it can be used to produce print-quality publications. The information contained in the Level 3 files will be totally owned by the Government and available for unrestricted use. The Level 3 tapes will be available for sale.

The status of key agreements is:

1. Chemical Abstracts wants the use of its materials restricted to ERDA only and may not agree to participate at Level 3

2. Engineering Index gives no limit on the use of its input except that there be no abstract journal produced in competition with EI. EI has agreed to index according to ERDA specifications at a cost of $20 to $25 thousand for the first year and for $6 to $7 per item thereafter.

3. Physics Abstracts materials have negotiated to provide camera ready copy of its materials for a fee of $10 to $11 per item plus a development fee of $20,000.

The key issue common to the ERDA agreements is that ERDA will not publish additional indexes and abstracts.

The relative contribution by the parties of agreement is expected to result in 40% of the materials in the energy information data base being provided by exchange agreements with other organizations, principally Government agencies and international bodies. At present information is included from the International Nuclear Information System, NASA and NOAA. Another 30% of the information will be acquired by purchase or lease arrangements. Files acquired in this way are Pollution Abstracts, the Environmental Information Center files, Engineering Index, NTIS files, and Physics Abstracts.

The remaining 30% of the bibliographic data base will be compiled by ERDA.

When the system is completed to Level 3, this will provide coverage of the U.S. nuclear literature and other relevant literature not covered by other organizations.

On the international scene, ERDA supports the IAEA International Nuclear Information System along with 44 other countries and 13 international organizations. ERDA receives most of its foreign literature through its association with IAEA.

ERDA has bilateral information exchange arrangements with foreign governments by which each provides to the other duplicate copies of their IAEA input in machine readable form so that this material can be announced more currently in NSA.

ERDA participates in the Government/Industry Data Exchange Program (GIDEP). GIDEP maintains specialized data banks which are available to both Government and Industry. It is a cooperative activity to provide automatic exchange of technical data during the life cycle of projects to compatibility, reliability and reduce costs.

The data banks are:

1. Engineering Data Bank
2. Failure Rate Data Bank
3. Failure Experience Data Bank
4. Meteorology Data Bank

2.3 Economics and Marketing

ERDA is an interagency service center. It does not charge ERDA agencies for services. Its tapes are available for sale for approximately the cost of duplication and handling. Marketing to non-ERDA markets if left to the private sector for its special information products and to NTIS for its technical reports and published products.

2.4 Scope of Services

The energy information data base will cover "significant" literature falling withing the following 11 categories:

1. Basic research support
2. Energy conservation and management
3. Energy engineering
4. Fossil and synthetic fuels
5. Geothermal energy
6. Nuclear explosion power
7. Nuclear fission power
8. Nuclear fuels and waste
9. Nuclear fusion
10. Radioisotope power
11. Solar energy

As a matter of policy, ERDA's audience is ERDA's R&D scientists, engineers and managers. The energy information data base at Level 3 is unrestricted in use. Levels 1 and 2 are proprietary. ERDA's contractors are also eligible users.

For the present, the ERDA information program is a bibliographic service. Interest in fact retrieval services has been expressed but no efforts have been undertaken in this regard.

The ERDA energy information data base is a machine-readable data base designed primarily for exploitation by machines. This applies to all three levels which are available for on-line retrieval to ERDA through ERDA operated utilities such as the ERDA/RECON network. Tapes are also used in accordance with various contractual arrangements made with suppliers, for SDI and standard profile search at the various ERDA laboratories.

In addition to its computer-based services, ERDA produces the serial Nuclear Science Abstracts on a semi monthly basis and a variety of special purpose non serial services.

3.0 FUTURE PROFILE

As a new executive agency, ERDA is still sorting out appropriate needs and goals to define its mission. For the present, it is attempting to stay abreast of feasible, alternative modes of operation. Its principle direction is to build upon the experience of the former AEC system and expand it to the broad

needs of non-nuclear energy research, principally coal research and energy conservation research.

3.1 Technology

The technological resources for information processing at the Oak Ridge facility represent the current state of the art in computer technology as well as document handling technology. For dealing with full text storage, retrieval and dissemination ERDA relies on NTIS.

The only change contemplated is further development and expansion of ERDA/RECON. A new large mass storage device will be installed at the computer facility of the Union Carbide Corporation, Nuclear Division, to extend the number of nodes available for new terminals (over the present 24) and to facilitate dial-up communications for the 6 research centers that were part of the Department of the Interior.

ERDA is investigating the feasibility of fact retrieval. For the present, the information office is deferring to ERDA's Management Information group to develop fact systems. In the Information program two issues are of interest.

1. improving retrieval through data tagging
2. providing an effective document delivery system for ERDA within the next ten years. The assumption at this time is that it will have to be a microfilm based system

ERDA has an information program R&D budget of $500,000 which is being directed at projects in these two areas.

3.2 Organizational Structures and Affiliations

Some possible organizational changes, although there is much uncertainty, are

1. ERDA and FEA could merge, with ERDA absorbing FEA information systems
2. The AEC military program (e.g., weapons) may be transferred to DoD

There will have to be further developments to resolve the potential conflict between ERDA and the private sector. For the time being,it is not possible to assess which posture the cooperative effort is likely to take.

Certainly,ERDA will continue to maintain a strong, parochial information system and can be expected to pioneer new developments perceived as necessary to the ERDA mission and which are not forthcoming from a private source.

3.3 Economics and Marketing

ERDA's tradition of absorbing costs for information processing shows no indication of changing. Marketing has not been an active part of ERDA's information program and this situation is also unlikely to change.

3.4 Scope of Services

The outstanding characteristic of ERDA's future service is its intended emphasis on in-house mission in order not to jeopardize those agreements with the private sector which are fundamental to its expansion.

It will be necessary for ERDA to significantly expand its service in order to accommodate the non-nuclear R&D components of the agency. The subject fields will be covered from the purchased systems. Ultimately, the completion of Level 3 of the energy information data base will be attained and provide coverage in all energy fields as comprehensively as is now provided in the nuclear field.

4.0 CONCLUSIONS

Outside of ERDA itself, the creation of Level 3 of the energy information data base will make ERDA the prime resource for energy information in the U.S. and probably the world.

It will be left to other Government agencies and the private sector to utilize the machine readable files and provide their own systems for accessing the files. Agencies now using RECON as their retrieval system should have little difficulty in loading and running the ERDA files.

The R&D contributions of ERDA's Oak Ridge facility to the field of information science are apt to continue and provide some of the greatly needed innovation that could deal with document handling problems that are in various states of investigation at the present time.

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1.0 REASON FOR INCLUSION

NASA's Scientific and Technical Information Office (STIO) administers one of the largest and most comprehensive Federal technical information efforts. Its bibliographic information system has long been regarded by organizations faced with large scale document processing as one to imitate. It deals with scientific information for an RDT&E community with defense and civilian implications. It has a national scope and it is currently participating in a joint venture with DDC to explore interagency interaction potential.

2.0 CURRENT PROFILE

STIO acquires, evaluates, and processes domestic and foreign aerospace scientific and technical literature; develops and utilizes advanced systems and techniques for data processing, storage, and retrieval; issues announcements, abstracts, and indexes to documents and publications containing pertinent information in the aerospace field; publishes scientific and technical documents; provides literature searches and bibliographies; develops special announcement mechanisms; produces and distributes aerospace documents in microform; and coordinates the NASA-wide library program. An advanced data processing system developed by STIO is NASA/RECON (REmote CONsole), a nationwide retrieval network linking installations and libraries across the United States.

2.1 Technology

Central information processing equipment used includes IBM 360/50 and IBM 1401 computers, Telefile 270X Communications Controller, and 18 2314 double density disk drives.

The operating system is IBM OS MVT II; the programming languages used are PL/1, COBOL, Assembly, MARK IV; principal systems are NASA/RECON for on-line retrieval by remote consoles, NASA/STIMS for file maintenance, publications, and linear searches, and NIOPS for on-line input and photocomposition.

NASA/RECON is an on-line interactive information retrieval system which became operational in February 1969 with seven stations. It is now a nationwide network, with 28 stations linking NASA installations across the country to the central IBM 360/50 computer. The user interfaces directly with the central master data base and is able to extract from approximately one million citations, a manageable number from which to select those most responsive to his query. The physical elements of a remote RECON station includes a standard keyboard plus 16 function keys, a 12-inch CRT display screen (at 300 characters per second); and a teleprinter operating at slower speeds (10 to 30 characters per second). The remote consoles were originally connected to the central computer by five leased telephone lines which were shared for on-line retrieval 12 hours a day, with capability for immediate on-line printout as well as off-line printout for later delivery. Dial-up access is reported to have become possible recently.

Holdings consist of machine-retrievable citations to approximately 560,000 NASA reports and 320,000 items from the published literature. The data base represented by the published literature is processed by the American Institute of Aeronautic and Astronautics.

In addition to providing access to the NASA files through NASA/RECON, STIO produces two semi-monthly comprehensive indexes and several publications:

- Scientific and Technical Aerospace Reports - STAR (technical report index)
- International Aerospace Abstracts - IAA (published literature)
- Computer Program Abstracts - CPA (quarterly)
- Selected Current Aerospace Notices - SCAN (monthly) - a current awareness service available to NASA offices, contractors, and grantees
- Continuing bibliographies on special subjects

Microfiche and hard copy materials are available to NASA users. Microfiche is available as 105 by 148mm diazo (4x6) fiche of negative film, each with 97 pages at 24X reduction. Hard copy is provided at $.05 per page when requested. Original distribution of NASA publications is free of charge to NASA installations. NASA users and contractors are served from STIO's contract operated facility. Non-NASA users can receive unclassified materials from NTIS.

2.2 Organizational Structures and Affiliations

STIO is funded as a support program for NASA R&D effort. It is virtually self-sufficient. Its only formal arrangements with other agencies are with NOAA and DDC with whom NASA has exchanged access terminals.

NASA/STIO has shown an interest in cooperative ventures of several types. NASA's Office of Technology Utilizations has established six Regional Dissemination Centers across the country, each operating independently and offering a variety of services to fee-paying industrial clients. NASA makes its computer tape of indexed documents from around the world available to these centers. The centers constitute a network which provides facilities where reports relevant to a client's specific needs may be retrieved.

The centers are:

Indiana University
Aerospace Research Applications Center
Bloomington, Indiana 47401

North Carolina Science and Technology Research Center
Research Triangle Park, North Carolina 27709

University of Connecticut
New England Research Application Center
Storrs, Connecticut 06268

University of New Mexico
Technology Application Center
Albuquerque, New Mexico 87106

University of Pittsburgh
Knowledge Availability Systems Center
Pittsburgh, Pennsylvania 15213

University of Southern California
Graduate School of Business Administration
Western Research Application Center
Los Angeles, California 90007

Regarding R&D efforts, NASA is currently cooperating with DDC on a project to investigate the feasibility of natural language processing and machine aided indexing (MAI). It is also cooperating with an exchange of terminals in the central facilities of the two agencies. At this time the purpose of the exchange is to give each the capability of becoming familiar with the other's system. Technologically, it is more likely to achieve complete compatability with the ERDA version of the RECON system. However, there is only 1% of overlapping interest with ERDA while there is approximately 25% overlapping interest with DDC.

2.3 Economics and Marketing

Cost data for operations or R&D was not available.

Marketing efforts are underway for STIO to distribute to all NASA scientists a guide manual for the use of STIO services.

Outside of NASA, STIO makes no marketing effort.

2.4 Scope of Services

Subject coverage is world-wide aerospace information, including: spacecraft and launch vehicle development, aeronautics and aircraft (also hilicopters,

STOL, supersonic, and hypersonic); auxiliary space power; human factors in aerospace environments; space electronics and communications; properties of the earth, moon, sun, and planets; cosmology; optical and radio telescopes (particularly balloon or space-borne); origins of life and possibility of extra-terrestrial life; aerospace applications to meteorology, communications, and earth resources; supporting research and development in fluid mechanics, thermodynamics, structures, mathematics, and basic physics and chemistry.

Input is provided by journal and conference literature generated by NASA research centers, contractors, and grantees; report and journal literature from government agencies, private industry, academic organizations, and research institutes; publications from foreign aerospace-related organizations; and reports from related organizations through exchange agreements.

STIO services are limited to NASA-associated organizations, contractors, subcontractors, and grantees.

3.0 FUTURE PROFILE

3.1 Technology

In July 1974, NASA completed a hardware configuration study of its contract facility. A program to upgrade its computer and communications network in line with the conclusions and recommendations of the study is expected to be a dominant issue in the next decade.

Its present IBM 360/50 central processor has reached its service capacity. Its main limitation is its inability to support additional RECON terminals. A likely replacement is an IBM 370/58 or a 360/65. Trade-offs described in the hardware study showed that for the long run (over 6 years) an IBM 370/158 would be able to fill all the requirements foreseen. However, the IBM 360/65 is less costly, but it will be saturated by 1979, unless administrative decisions are made to limit the growth of the system. Growth factors are:

- Improve data tagging: data, tables and charts in reports are not currently well identified or retrievable.

- Consider the structuring of special numeric value files, particularly those already in existence at some NASA information centers such as Goddard's files of raw satellite-transmitted data. Other useful files could give properties of alloys.

- Collection and evaluation of user feedback to help refine RECON's response.

- Examine system compatibility with other agencies (e.g., DDC and ERDA), exchange terminals and eventual message switching and command translation to facilitate mutual accessibility.

3.2 Organizational Structures and Affiliations

NASA/STIO will cooperate with other agencies in order to solve problems of mutual concern.

Negotiating with other agencies, either to have them provide information services to NASA or for STIO to process information for others, is unlikely. STIO is likely to act only as a service office funded by and for NASA alone. Resource constraints, which NASA is currently experiencing, are an unknown force that could have unpredictable effects on NASA's insular operation.

3.3 Economics and Marketing

STIO is interested in promoting the use of its products by NASA scientists and engineers, particularly RECON. It has an in-house project to distribute user guides directly to NASA scientists and to encourage increased use.

The charging of costs to contractors, and, in some cases, other Government agencies, has begun. As operating costs rise, it is likely such costs will continue to be passed along.

3.4 Scope of Services

For the near future, the subject content and the nature of NASA's products is unlikely to change. Within the decade, changes in STIO's scope of services will be of two kinds:

1. Size of the data base

   - RECON files grow at the rate of 60.3 million to 63.6 million bytes per year

   - New files for FY 1976 are likely to require between 193 million and 264 million bytes (including adding abstracts, adding a "safety data base" and adding purchased files of Chemical Abstracts and Engineering Index for example.)

2. Adding more RECON terminals

   - Either the IBM 370/158 or a multiplexed IBM 360/65 is capable of handling 100 terminals which is consistent with NASA's 6 year goal

The communication system now supports 28 Bunker-Ramo terminals with five 2400 to 9600 baud leased lines. For the updated system, a packet switching configuration was considered as an alternative to the present leased lines. Cost effectiveness trade-offs favored the continuation of the leased lines which support six or seven terminals each. New communication modems will allow quadrupling the sharing capacity of the lines.

Software systems are expected to remain "fundamentally adequate if the NASA publishing and product packaging remains unchanged." Even if new technology (e.g., chip technology and emulators) favors more efficient software design, conversion reinventment is likely to be prohibitive. Even the development of machine independent software is not being considered. Communications with other systems will be accomplished, as needed, by trading terminals.

In document handling technology, NASA expresses specific goals, but the choice of techniques and technology for accomplishing the goals is undetermined. Goals are:

- Investigate natural language indexing as an alternative to its present costly manual indexing. Alternatives are

  - full text searching
  - manual indexing with a thesaurus
  - machine-aided indexing

  A target date for a decision is 1976 or 1977.

1. Present files are likely to undergo restructuring to favor more precise retrieval, emphasizing current literature, providing data tags and indicators of some sort to aid searching strategy

2. New files, expecially numeric files, products of NASA's information analysis centers, and purchased files will be added to RECON.

4.0 CONCLUSIONS

As is typical of the large Federal information centers, NASA's STIO will exercise influence over the developments in the field of information science by what it does to improve its own operations. It will make an impact in both its role of processor/supplier and as an information consumer. Steps taken to improve the performance of its system will undoubtedly be announced outside of NASA and be used by other agencies which might benefit from NASA's experience. This is particularly true of any joint actions of NASA with equally influential agencies such as DDC, ERDA, and NOAA.

NASA contributions to the nature of the information community of 1988 could be in the form of optimizing main frame and I/O utilization of large scale systems, some software developments, and improved technologies for document delivery, data storage, and retrieval, and improved methods of indexing and/or abstracting.

National Agricultural Library
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Beltzville, Maryland 20705

Samuel T. Waters, Deputy Director, Resource Development (301) 344-3780

1.0 REASON FOR INCLUSION

As a national library serving a technical clientele, the National Agricultural Library has demonstrated leadership in developing mechanized information products which are widely used and are compatible with a variety of modes of operation. The Library operates in an R&D environment and provides bibliographic and data information services to a user environment similar to that of DDC.

2.0 CURRENT PROFILE

2.1 Technology

NAL's technological profile is characterized by an underlying principle that it will rely on the public sector to provide the technological systems for operations. Therefore, the technology employed at NAL provides only input processes for its library functions which creates the basic input to the CAIN data base, an automated index file to over 100,000 agriculture journal items. For retrieval, users of the CAIN data base have direct-line terminal access to the Lockheed Information System, and NLM's MEDLINE, and the SDC's system via Tymnet. CAIN is maintained by bothSDC and Lockheed. In addition, the Agriculture Law Library has Bunker-Ramo terminal access to the JURIS system. NAL is also experimenting with the N.Y. Times system on a Hazletine terminal.

For input processing NAL has discontinued key to card input in favor of direct keying three Sanders mini-computers each with three slave CRTs with input format display. NAL produces update tapes for their principal products (Bibliography of Agriculture and the NAL catalog) which are then used by commercial firms to produce all the final products. Development costs incurred by NAL when Lockheed first put CAIN on-line were $25,000 to $30,000. CAIN now is growing at the rate of 8,000 items per month.

NAL cataloging is done using the Ohio College Library Center (OCLC) system. All publications of the Department of Agriculture (DoA), reports of DoA supported research and the Library collection of 1½ million volumes are included.

Full text materials are distributed as 35mm microfilm and as hard copy photoprints, CAIN is distributed monthly on magnetic tape. Programs for processing CAIN are not supplied by NAL but data format descriptions are provided at the time of purchase.

2.2 Organizational Structure and Affiliations

NAL was established as part of the DoA in 1862. It is part of the DoA's Office of Conservation, Research and Education and serves the entire DoA, as well as other government agencies, in all library matters in the field of agriculture. The Library's mission is to collect and make available at least one copy of all substantive publications in agriculture.

NAL effectively coordinates an information program which incorporates in its own organization for-profit companies (ORYX, SDC, Lockheed, and Ravman and Littlefield) and a not-for-profit (OCLC) in a formal network designed to fill the design criteria set by NAL.

2.3 Economics and Marketing

NAL assumes the costs for creating the initial input files and arranges for commercial firms to market the NAL products as described in Section 2.2. Costs to NAL are not available on a product basis because several products are produced in the over all system. The total budget for NAL systems is $5.5 million.

2.4 Scope of Services

NAL products provide comprehensive world wide coverage of agricultural literature. Specific technical fields covered include botany, chemistry, entomology, forestry, food and nutrition, law, water resources, and economics.

NAL's audience is unrestricted. It serves all government agencies in matters of agriculture and the general public according to requests.

Its principal products are solely bibliographic:

- CAIN data base - cataloging and indexing system for the current materials
- Bibliography of Agriculture - published index to holdings
- National Agricultural Library Catalog - monograph catalog
- Agricultural Economics - published by the American Agricultural Economics Association from CAIN tapes

Services provided include computer and manual literature searching, photocopying, interlibrary loan, and reference service.

3.0 FUTURE PROFILE

3.1 Technology

Since NAL is directly involved only in the input processes, word processing technology is of prime interest. Successful experiences with the OCLC system for cataloging has created an interest in extending the concept of intersectional input in two ways:

1. use it for interactive indexing and abstracting input
2. catalog NTIS files in OCLC format

NAL would like one comprehensive Federal organization (system for library material input, processing and output, including document location indicators and eventually document transmission. NAL is looking to OCLC as a model for the national document center because of OCLC's present success. NAL's role would be as contributor to such a system.

The major problems to be overcome are:

1. conceptual
2. human
3. organizational

Plans for upcoming development include:

- Putting DoA field libraries in the research centers on-line with commercial services
- Extended current awareness program
- Extending the reference service by purchasing available services such as the N.Y. Times Information System

New developments may be required in hardware and software as well as in communications technology. NAL's expressed attitude is that if such developments are required they will come.

Beyond the foreseeable plans, NAL is interested in having the capability of providing full text via CRT, but the cost/benefit ratio is still unsatisfactory.

3.2 Organizational Structure and Affiliations

NAL expressed serious interest in cooperative arrangements and is likely to be receptive to such proposals if and when they are made.

NAL is active in MARC efforts to resolve standardization problems of bibliographic nature. If standardization can be brought about NAL expects to see one or more national bibliographic control systems take over many of the functions now performed by many Federal Agencies such as ERDA, NLM, DDC and NASA. In such an arrangement, it is likely that commercial organizations would play a significant role.

3.3 Economics and Marketing

Information file-building costs will continue to be a part of NAL's budget. Although it sells its products, it is not on a cost recovery program. Costs for retrieval will be funded centrally with an increasing development of remote installation of commercial systems.

Commercial vendors will continue to market NAL products.

3.4 Scope of Service

The nature and size of NAL services and audience is apparently fairly constant. Its products and services are likely to be packaged by commercial vendors

following the capability of the state of the art.

4.0 CONCLUSIONS

Current indications are that there will be little occasion for NAL/DDC interaction in the period to 1988.

Its role then is likely to be basically as it is now. As a major library it may be an important contributor and supporter of library networking. The amount of overlap in the DDC and NAL services tends to be minimal and their interests are likely to continue to diverge.

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1.0 REASON FOR INCLUSION

The NBS Office of the Associate Director for Information Programs (OIP) focuses the flow of scientific information into and out of NBS. It is responsible for the internal exchange of information as well as channeling NBS output to other Federal agencies, industry, universities and the public. It promotes international cooperation in information activities. Within this Office is the Office of Standard Reference Data (OSRD) which administers the National Standard Reference Data System (NSRDS) (an outstanding data oriented scientific information system directed toward improving the reliability and accessibility of quantitative data about the properties of materials). NSRDS is unique as a national information system which is based on data retrieval as opposed to bibliographic citations.

2.0 PRESENT PROFILE

OIP is responsible for five information functions in NBS.

- Generation (publications)
- Dissemination
- Accessability
- Quality Control
- Technology

The NSRDS is a decentralized, cooperative network of data centers and data compilation projects funded by NBS. It constitutes a logically coordinated network rather than a physical one.

2.1 Technology

The principal automation technology employed by OIP is in the Office of Technical Publications (OTP) and at various NSRDS installations.

OIP publishes about 25,000 pages of material a year in the bureau's 14 publication series, its bibliographic subscription services, and in outside scientific and technological journals. OSRD's developmental work is continuing in computer-assisted photocomposition ("electrical printing"). A recent significant development was in the interface program that makes possible the use of NBS's General Purpose Scientific Document Image Code (GPSDIC) for photocomposing technically complex manuscripts.

Three NSRDS centers now use automated text processing systems: a line printer with full capability for printing GPSDIC and programs for using these records to drive a Linotron photocomposition machine; the routines are used on a Univac 1108 computer and are written in FORTRAN.

OIP does no hardware development but it does support software development in its data centers. All programs are made available through NTIS. OIP support favors decentralization over large scale, comprehensive systems.

NSRDS is a fact (data) handling system as opposed to a bibliographic reference system.

The principal output of the NSDRS program is evaluated data, and critical reviews of the status of data, in particular technical areas. The technical scope of the NSRDS program is restricted to well-defined physical and chemical properties of substances and systems which are well-characterized. Properties which depend upon arbitrarily defined characteristics of the measurement technique are generally excluded. Likewise, materials of uncertain or variable composition are not included. Biological properties and data relating to large natural systems (e.g., the atmosphere, the oceans) also fall outside the program.

Data evaluation consists of a careful examination by an experienced specialist of published measurements of the substance or system in question leading to the selection of a recommended value and a statement concerning its accuracy or

reliability. The techniques of evaluation depend upon the data in question, but generally include an examination of the method of measurement and the characterization of the materials, a comparison with relevant data on other properties and materials, and a check for consistency with theoretical relationships. Documentation is provided for the selections of recommended values and accuracy estimates. Evaluated data produced under the NSRDS program are disseminated through the following mechanisms:

> Journal of Physical and Chemical Reference Data - A quarterly journal containing data compilations and critical data reviews, published for the National Bureau of Standards by the American Institute of Physics and the American Chemical Society.
>
> NSRDS-NBS - A publication series distributed by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
>
> Appropriate publications of technical societies and commercial publishers.
>
> Response by individual data centers to inquiries for specific data.

NSRDS emphasizes data that are applicable to current problems of national concern. Data disseminated by NSRDS on thermodynamic, kinetic, atomic, molecular, and other properties, have found applications in energy R&D, environmental quality, and improvement of industrial efficiency.

2.2 Organizational Structures and Affiliations

The Information Program Office is administered by the NBS Associate Director for Information Programs. Its components are the Office of Standard Reference Data, the Office of Information Activities, the Office of Technical Publications, the Library Division and the Office of International Relations.

OSRD seeks to cooperate with other Government agencies and with private groups who require reliable property data. The data centers within NSRDS have extensive files which frequently make it possible to prepare specialized data compilations with minimum effort. For example, one recent activity concerned the Climatic Impact Assessment Program, sponsored by the Department of Transportation.

Here, a standardized data base on rate constants of chemical reactions was provided for use in the modeling of stratospheric chemistry, as part of the effort to assess the consequences of pollution from SST flights. Other data compilations have been prepared for the design of industrial incinerators and the transfer of cryogenic fluids.

OSRD also maintains close contact with data compilation activities abroad. Liaison has been established with national programs in several countries, including the Soviet Union, in an effort to avoid needless duplication and to encourage coverage of important technical areas. The office is also active in CODATA, the Committee on Data for Science and Technology of the International Council of Scientific Unions.

NBS's Center for Computer Sciences and Technology, in addition, provides general consultation and advice in data processing management and procurement policies and to assist individual agencies in solving specific automation problems.

2.3 Economics and Marketing

The results of NBS work are communicated to the scientific, engineering, and business communities, and to consumers, primarily through a formal publications program and by direct inquiry to the data centers.

There is no common cost and marketing policy among the OSRD data centers.

2.4 Scope of Services

NBS' primary audience traditionally includes scientists, engineers, and other technologies. The audience has broadened to include the business community, educators, environmentalists, economists, safety experts, energy conservationists of all disciplines, and the general public. The Bureau's Consumer Information Series exists primarily to serve the general public. Also, as a Federal authority on the metric system of measurement, NBS is serving as a major source of metric information for laymen and research scientists. Approximately 57,000 requests for metric information were answered during 1974 from members of Congress, industry, education, and the general public.

Services include collection of critically evaluated data compilations and critical reviews; reference and referral services; state-of-the-art compilation; limited manual literature searching for outside users; and limited advisory and consulting services.

3.0 FUTURE PROFILE

3.1 Technology

Technologically, OIP is committed to a policy that a human interface is essential in information transfer. The interface is seen as an analyst who is also a working scientist closely allied with the collection and use of the data being evaluated. The ideal information system (in this view) would be an expanded network of closely related specialized information centers evolving in three stages.

1. Logical connection of information analysis centers with highly specialized subject orientation
2. Evolution of a centrally managed and coordinated network
3. Finally, the establishment of standards for IAC's to formalize the structure

The pattern of growth would involve a complementary development of both national and international information centers which would augment the value of published results by providing critical analysis that puts data into the perspective of other data in the same area of research.

Hardware and software developments in this concept are incidental.

The breakthroughs which predicate significant success of the proposed scheme are perceived as social, not technical. First, there would need to be a government commitment to the concept which is not now the case; and, second, there would need to be greater social awareness of the usefulness of evaluated, standard data.

It is believed that initial success will be achieved in three subject areas before 1988 because they are of international concern, they are reasonably advanced

at the present, and the necessary data are able to be acquired. The three areas are:

1. Nuclear research (now)
2. Energy research (before 1988)
3. Environmental research (by 1988 or shortly after)

3.2 Organizational Structures and Affiliations

NBS is, by its very function, an agency which encourages cooperative arrangements; however, it is a service agency to others and as such is not in a leadership position, nor does it control resources to ensure cooperation.

OSDR has been well received and therefore is likely to continue to be able to support additional nodes in the comprehensive, conceptual network of scientific information centers that is envisioned.

Realistically, the total system is regarded as a goal which will be only partially attained.

NBS affiliations are most likely to be with agencies with national goal like ERDA, EPA and NOAA are the most likely to be seen.

3.3 Economics and Marketing

There are no indications that the OIP economics and marketing profiles will change. OIP indicates that the cost of research would be increased one to two per cent to achieve the proposed level of critical evaluation.

3.4 Scope of Services

The present information program tends to relate to intermediary organizations more than ultimate users. The increased scope of services brought on by demands from business and the public at large could have some influence on OIP services. Such a trend is likely to be more detrimental than beneficial to the scientific community now served. Since resources for new services are limited, they would compete with the present programs rather than be additional to them.

4.0 CONCLUSIONS

Standardization, quality control and critical evaluation of technical research areas of measurement and data reporting characterize the NBS program. It is interdisciplinary and although it closely collaborates with other Government agencies, industry, and universities it is not directly in the business of providing information services to specific problem related organizations.

As a result, NBS supported programs are likely to be felt across disciplines and could have a stabilizing effect with the scientific community. The most optimistic result from such an effect would be that the scientific user community of information services would begin to contribute effectively to the development of truly useful systems. Common awareness of the importance of standard reporting procedures would make the input problems more solvable, and informed users would be easier to serve.

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1.0 REASON FOR INCLUSION

The National Library of Medicine (NLM) was originally the Library of the Army Surgeon General's Office. From 1952 to 1956 it was known as the Armed Forces Medical Library. In 1956 it was transferred to HEW and made a national library. Its close association with the Department of Defense continues through the appointment of representatives from the medical branches of the Army, Navy, Air Force and the Veterans Administration to serve on NLM's 10 member Board of Regents which advises the Secretary of HEW on policy matters affecting NLM.

Technologically, NLM has traditionally demonstrated pioneering ability in modern dissemination of information. Of particular interest is NLM's capability for on-demand duplication and distribution of materials and the computerization of information storage and retrieval.

2.0 CURRENT PROFILE

2.1 Technology

NLM is a technologically sophisticated agency providing access to library information in approximately 40 biomedical areas. The sources of material collected and processed include over 500,000 books, journals, technical reports, documents, microfilms and audiovisual materials. Open, published literature is the medium for the dissemination of most medical information (for military and civilian medical research). Consequently, NLM activities emphasize the open

literature. In this respect, NLM differs significantly from the DDC which is solely concerned with technical reports (the popular medium for engineering and applications oriented research results).

The NLM's computer-based Medical Literature Analysis and Retrieval System (MEDLARS) employs two IBM 370/158 computers to provide bibliographic control to the world's biomedical literature. Both on-line and batch capability are provided. The on-line system (International Data Communications Network) supports 600 remote terminals in current use.

This on-line system is operated through TYMSHARE, Inc. and used by NLM for the MEDLINE network. All DoD medical libraries are reported to have MEDLINE terminals supplied by NLM.

In addition to the on-line services, NLM provides access to medical literature by:

1. preparing citations for publication in Index Medicus and the NLM Current Catalog
2. compiling recurring bibliographies on specialized subjects of wide biomedical interest
3. publishing and distributing selected literature searches on a wide basis
4. supporting a network of eleven Regional Medical Libraries to provide access to full text documents through interlibrary loan

2.2 Organizational Structures and Affiliations

NLM has traditionally operated as an insular agency within the information processing community. It has purchased contract services commercially and supported IS&R software development and communications research (e.g., SDC's ORBIT III).

The Lister Hill National Center for Biomedical Communications acts within the Library to apply computer and other communications technology to the fields of health care delivery and to aid health service education and biomedical research.

The MEDLINE data base has been made available to information service vendors on a non-exclusive basis. The NLM has strongly maintained that it has

the direct responsibility to provide comprehensive information support to the U.S. biomedical community. Thus, it continues to be the prime resource of the national biomedical information delivery program.

NLM views its role as that of a "wholesaler" of information. Its services are provided to four or five thousand medical libraries, primarily through the Regional Medical Libraries. MEDLINE terminals are usually installed in libraries and are operated by personnel trained by NLM.

On the international scene, NLM is currently a party to eight bilateral agreements with major foreign medical organizations. In general, NLM has made its resources (including MEDLARS and MEDLINE) available to other nations in consideration for their supplying input covering the foreign medical literature. amples of international cooperation include a direct hook-up via satellite with the National Lending Library in England and the operation of the NLM data base and software by the Karolinska Institute in Sweden.

2.3 Economics and Marketing

The NLM estimates for the costs of its services are given in terms of "costs outside the walls of NLM." NLM policy is that its costing basis is analogous to that of other information processing agencies, which fund all costs related to the conduct of a given project, including the document preparation, and then recover only the cost of dissemination.

On a per search basis the cost of NLM searches is now approximately $3 per search for about 400,000 searches per year. Search costs are expected to decrease as volume increases.

The NLM is actively seeking to improve the efficiency of its systems and lower the costs. In this regard, it has funded the development of improved software systems and has assumed greater in-house responsibility for services such as MEDLINE and TOXLINE, and, consequently, reduced its reliance upon contractor operated services.

The NLM is not in competition with any other Federal agency. Its scope of services is unlikely to overlap those of other government agencies, including DDC. Its mission includes serving the DoD biomedical community, and, as such, its services complement those of DDC.

2.4 Scope of Services

The subject scope of chemical and biomedical sciences imposes the only theoretical limitations on the services to be provided by the NLM.

Its ultimate audience is the world biomedical community. However, its prime audience is the community of four to five thousand U.S. biomedical libraries, which NLM serves through its Regional Medical Libraries.

Its products, in addition to traditional library services, include three prime data bases:

- MEDLINE - journal citations and subject indexing (no abstracts)
- TOXLINE - a free text search system for a bibliographic data base oriented to the toxicology of natural and man-made chemicals
- SERLINE - bibliographic data in the serial holdings within the Regional Medical Library Network

By-products that are available from NLM (mostly on a quid pro-quo basis with other nations) include NLM production tapes and the processing software.

3.0 FUTURE PROFILE

3.1 Technology

Technologically, NLM's pioneering advances are likely to come in the area of document and information handling technology rather than unique hardware or software development. Using state-of-the-art technology, NLM is expected to improve services currently available, making service faster, cheaper and more accurate. NLM's technological contributions to the information community are likely to be in the adaptation of general purpose components for effective use in the biomedical environment.

NLM's most significant problem (without a foreseeable satisfactory solution in sight), is supplying full text of documents. By 1988, NLM can be expected to

have a mechanism for the elctronic delivery of full text to its users, probably based on a microfilm master file, although the characteristics of such a system are currently highly speculative.

NLM goals for 1988 or before include:

- Operating cost reductions through computer applications which exceed the most optimistic current estimates (brought about by unit cost reductions from increase in volume of usage)
- On-line access to fulltext and factual data rather than citations (e.g., the trend is beginning with the provision of data bases such as an NLM toxicology data file with reported values for 1000 common toxic chemicals)
- The trend to on-line services will increase with access for "free exchange and use of common data bases".
- International standards will be achieved, if the problems of economic and political self interest can be solved (standard protocols for calling up systems is to be expected at NLM)
- NLM expects to see mini and microprocessors used for input processing for its computer-based systems. Possibly special products will have to be produced for remote use with a variety of minicomputer installations. Products could consist of data files, software or both.

3.2 Organizational Structures and Affiliations

The NLM anticipates no major modification of its organizational structure vis a vis the national information processing community. There is a realistic recognition that the national configuration of information agencies will reflect the impact of economic forces. Resource constraints will tend to favor consolidation, standardization and cooperation. Economic recovery and greater resource availability (people more than dollars) will tend to favor the opposite.

3.3 Economics and Marketing

NLM serves a homogeneous audience which is aware of the NLM services through the biomedical library network. Since NLM prefers to act as a wholesaler of information, little marketing effort is made.

Costs of NLM services are expected to continue to decline. NLM efforts to improve the efficiency of its operations and increased volume of usage are apt to ensure this trend.

3.4 Scope of Services

The scope of NLM services is likely to remain unchanged in content and audience so long as NLM functions as a biomedical national library.

The nature of its products and services is likely to undergo substantial modifications in the period 1975 to 1988:

- Centralized, on-line services will be expanded
- Literature services will be supplemented or replaced with factual answer services
- Full text document ordering and delivery will be improved:
  a. at first, through the improvement of SERLINE to permit the automatic generation of an interlibrary loan request
  b. eventually to provide electronically transmitted and remote duplication of full text materials at acceptable costs.
- A national, medical audio/visual center will be developed by NLM in the near future

4.0 CONCLUSIONS

At first glance, there appears to be little commonality between DDC and NLM. The scope of services tend not to overlap because the selection practices and policies of each agency tend to exclude the interests of the other.

On the other hand, both DDC and NLM are agencies with a mission directly tied to major, national goals: defense and health. NLM has close traditional ties to DoD and actually provides service to a segment of DoD scientists. Both agencies have a large, national scientific audience.

Consequently it seems reasonable that technological interfaces are both desirable and feasible. The potential exists for mutual investigation of

- on-line communication systems
- special packaging of information products for distribution and remote independent use

- interchange of data bases or subsets, particularly with DDC operating a system for DoD medical installations
- joint or coordinated support of research on document handling technology

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1.0 REASON FOR INCLUSION

The Environmental Data Service is part of a vast Government project to consolidate world-wide environmental data and information under one agency. Like DDC, it is an active information organization serving an R&D community. It is new and unencumbered by commitments to any on-going operation. In addition to undertaking an ambitious program in computer-based bibliographic control techniques, it is pioneering the development of a program to control raw data files of numeric values resulting from physical and marine biological measurements and observations.

2.0 CURRENT PROFILE

2.1 Technology

The Environmental Data Service is a combination publishing house, cataloging department, indexing service and international reference service. EDS is a funnel for both data and reports to be collected, analyzed, processed and distributed.

The mission of EDS is to provide environmental information and data to NOAA's R&D community and to the public at large. Major goals expressed by EDS are to:

1. Supply environmental data and information for its application in the assessment of national concerns and economic problems
2. Develop a modern, interdisciplinary data and information storage, retrieval and referral system capable of handling the high volume of NOAA output with technology capable of meeting new and expanding user demands
3. Provide data management, analysis, support, and processing services to other Government agencies on a contract basis

As a total system, EDS is still in the planning and development stages. Pieces of the system are operational but a five year program plan is not scheduled to be completed until December 1975 and the program options are regarded to be "wide open" at the time of this writing. The agency has chosen to defer a commitment to any specific technological program until it has defined "a sense of self" which reflects a well defined set of information and data requirements.

EDS' current policy is to purchase final information packages that suit a particular need. Special data bases as well as modular systems have been made a part of the EDS program in this way.

For services that EDS elects to provide on-line (OASIS and ENDEX), the commercial services of SDC and Lockheed Information Systems have been used. EDS funds the program for the NOAA community.

EDS avoids investments in the development of new information storage and retrieval technology. For the present, EDS has been able to rely heavily on the private sector and the professional societies to provide satisfactory technical solutions to their information delivery programs. However, a time may come when EDS will have to develop its own capabilities, if private industry is not able to produce the service that EDS is not able to produce the service that EDS is obligated to provide to the NOAA community.

Key technical issues being addressed currently include:

1. definition of how much information is an appropriate amount to supply a user
2. establishing some cost/benefit measure which is not necessarily related to price
3. improving document delivery (this is perceived as the least adequately solved of the information issues of the past 10 years)
4. oral/verbal communication problems

2.2 Organizational Structures and Affiliations

NOAA is part of the Department of Commerce. It was formed in 1970 through an executive reorganization, which resulted in an organization specifically concerned with environmental sciences, including the Environmental Science Services Administration (a merger of the Weather Bureau and Coast and Geodetic Survey) and the Bureau of Commercial Fisheries, and other related offices.

EDS is open to cooperative agreements, as indicated by its policy of buying packaged services. While it is a publishing house in its own right, it also makes its materials available through GPO and NTIS.

Organizationally, NOAA's EDS consists of five specialized data centers:

1. The National Climatic Center (climatic information)
2. The National Oceanographic Data Center (physical-chemical oceanography, ocean currents and marine biology)
3. The National Geophysical and Solar-Terrestrial Data Center (solar-terrestrial physics, undersea geology, geophysics, seismology and geomagnetism)
4. The Environmental Science Information Center (Literature and bibliographic control center)
5. The Center for Experiment Design and Data Analysis (directs the information retrieval portion of two international Atlantic Ocean surveys and a U.S. Canadian examination of the Great Lakes.)

2.3 Economics and Marketing

There is no charge for Information and data services to NOAA users. EDS uses the Lockheed Information Systems and SDC. NOAA's input costs for the ERIC bibliographic services is estimated at $38/document.

EDS recognizes a need to have an active marketing program, but, to date, has not established one.

2.4 Scope of Services

The subject scope of EDS is predominantly environmental sciences and marine biology. A more precise indication is provided in Section 2.2 describing the nature of EDS's data centers.

The NOAA community, especially the R&D offices, and the international public at large are the audiences served by EDS. The data centers work directly with end users as well as libraries and other information centers. They tend in this way to offer a retail-like service.

Many of the data and information files of EDS's data centers have been mechanized. The products are both bibliographic and fact oriented. The principal

products are:

1. OASIS - a full service on-line information retrieval service that provides reference to the technical literature

2. ENDEX (Environmental Data Index) - contains computer searchable descriptions of interdisciplinary files of environmental data on many levels. It has three major components:

   a. descriptions of data collection efforts
   b. descriptions of data files
   c. detailed inventories of large, commonly used files

   Descriptors list the parameters and volumes of data available, the method used to measure them, when and where the data were collected, the sensors and devices used, data formats, restrictions on data availability, publications in which data can be found, whom to contact and an estimated cost of obtaining the data.

3.0 FUTURE PROFILE

3.1 Technology

EDS will continue to rely upon available technology to put out variations of traditional services - indexes, abstracts, and sophisticated library services for technical reports and the open literature. Conventional as well as automated services will continue. Because no decisions have been made on many basic policy issues, it is not possible to provide an accurate profile of the EDS of the next ten years. Only the trend toward networking of information and library services is fairly certain to be reflected in EDS's eventual technical program. Developments to allow an extension of the interactive-type OCLC input to indexing and abstracting are also expected. EDS administrators would like to see a large, central document and report file similar to OCLC's book file, although this file is not expected to be implemented in less than 25 to 30 years. In the interim, some type of referral mechanism would be useful to switch a user from one scientific file to another within the same conceptual search.

3.2 Organizational Structures and Affiliations

Although EDS would like to see greater cooperation among Federal agencies and even a consolidation of information services, it is not actively pursuing this goal. The working assumption is that there will continue to be an intra-agency need to maintain an independent information program which caters to NOAA's needs. Owing to resource constraints, however, it is quite possible that EDS would participate in interagency cooperative ventures of mutual interest. A key goal

listed for EDS is "to provide information services to other agencies on a contract basis."

3.3 Economics and Marketing

EDS's future activity and profile in this area are still vague.

3.4 Scope of Services

The environmental emphasis in the EDS services is unlikely to change. The nature of the audience may, however, begin to shift from a technical group to include more of the general public. This is recognized as a significant audience which could influence the nature of the EDS products in the future.

Both the bibliographic and fact services are likely to continue. The form of the services will continue to reflect the state of the art in packaged services. More sophisticated, on-line retrieval and automatic remote document delivery will be provided by EDS when and if effective technological packages become available to do so.

4.0 CONCLUSIONS

NOAA, particularly EDS, is an interesting agency because of its novel use of raw data files and its openness to novel information storage and retrieval design. But until its information program is more adequately defined, it is difficult to relate NOAA to the probable information community of 1988. It may be another node in the Federal information processing community or it could be a maverick system with some unusual capabilities.

Its desired role of being a part of a centralized Federal system is not likely to be realized within ten years.

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1.0 REASON FOR INCLUSION

The National Technical Information Service (NTIS) is the civilian counterpart of DDC. It is a central source for the public sale of Government sponsored research, development and engineering reports and other analyses prepared by Federal agencies, their contractors and grantees - including non-classified, unrestricted reports generated within DoD.

NTIS was established to consolidate and improve information services for the Department of Commerce and over 150 other Federal agencies in much the same way that DDC is responsible for information services within the DoD. Originally, DoD was the largest and most influential input agent to NTIS with its "AD" document series. The DoD contribution is still significant although its role is reduced in relation to the total current NTIS activity

2.0 CURRENT PROFILE

2.1 Technology

NTIS distributes over 11,500 information products daily from a collection of over 800,000 titles covering science, technology, engineering, business, economics, library and information science.

Three processing streams are managed.

1. Input

    a. Reports
    b. Patent applications
    c. Computer software

2. Announcement

   a. Weekly Government Abstracts
   b. Government Reports Announcements
   c. Government Reports Index

3. Requests for copies (purchase orders)

An IBM 360/40 with extended memory is used to handle document processing. Two peripheral minicomputers (basically word processing units) provide support to preprocessing functions. OCR equipment is currently being evaluated and tested for use in processing request orders. A decision on the feasibility of several options is expected within FY 76.

NTISearch is the agency's on-line computer search service operated under contract by Lockheed Information Systems. It contains records to 360,000 Federally sponsored research reports completed from 1964 to date. Direct user tie-in to the Lockheed Information system is feasible with a compatible terminal; or, NTIS will provide custom searches for a fee.

NTIS' prime role is to market information products of its client agencies. However, it does abstract and index those reports which are not preprocessed by the sponsoring agency.

Microfilm files are the preferred medium for document storage and distribution, although hard copy documents are provided at a significantly greater price, when requested. 4x6 inch microfiche with 98 document pages per sheet are the basis for several microreproduction services: selected categories in microfiche (SCIM - an automatic document distribution service); SCIM/profile (a biweekly selective dissemination of information service); and, U.S. Patents (general and mechanical, electrical, and chemical).

The primary distribution mechanism for full text delivery is the U.S. Postal Service, which is regarded as inadequate.

2.2 Organizational Structures and Affiliations

NTIS was established in 1970 to extend and improve the role of the Clearinghouse for Federal Scientific and Technical Information which the Department of Commerce had operated since 1964. From 1946 to 1964 the role had been filled by the Office of Technical Services. Its budget growth from $5 to $15 million

between 1970 and 1976 indicates the extent of increased Federal investment in the NTIS program.

The NTIS' role is that of marketing agent and broker of information products for over 150 other government agencies with which formal agreements have been reached. Three modes of service are provided:

a) Client agencies can provide the full text reports and have NTIS do all the processing: indexing, abstracting, etc. (maximum cost)

b) Agencies can provide machine readable input along with their documents (least cost)

c) Agencies can provide the documents and manual data input forms which NTIS will process

NTIS is the marketing agent for non-textual information products such as NLM's MEDLINE and TOXLINE. It also markets the data base of the Smithsonian Science Information Exchange's current research information file.

Organizationally, NTIS is basically a self-contained, centralized production operation. Materials are processed and delivered from its Springfield Virginia location.

2.3 Economics and Marketing

NTIS is obligated by Title 15 of the U.S. Code to recover its cost from sales. The distribution of its information products and services is reported to be self-sustaining and 98% cost recovered. Even with some substantial increases in the cost of its products, the customer market is growing. All NTIS products and materials are for sale or lease, and use is unrestricted.

Efforts are underway to expand the NTIS market to other nations. Ten to thirteen marketing agents are trying to develop the world market. If expansion is successful enough, NTIS will either establish foreign branches or expand the Springfield operation to accommodate the expansion.

2.4 Scope of Services

NTIS' scope is defined by the interests of its client agencies. Broad coverage is provided in science, technology, business and health care. Filtering of the collection is left to the supplying agencies, thus coverage is uneven from agency to agency. Pricing policy is left to NTIS.

NTIS serves both individuals and organizations with an average of 11,500 information products daily. This includes full text reports, announcement services and custom searches. It serves a general, international audience without restriction.

NTIS products are primarily bibliographic. However, NTIS has cooperatively produced a variety of specific, one time products for certain customers. For example, NTIS computer systems were used to produce a special tabulation for the National Center for Health Statistics.

3.0 FUTURE PROFILE

3.1 Technology

Over the next ten years, NTIS anticipates no technological modifications in its operation that are beyond the current state of the art. Continued progress in data input with word processing equipment is likely. Technology is seen as neither a major problem nor a solution.

The greatest need for technological breakthroughs is seen in the area of document delivery and information (fact information as opposed to citations) delivery. However, for the foreseeable future, the mode of operation will be a central production facility with long distance freight delivery utilizing private services and the U.S. Postal Service for local delivery. Telecommunications for branch distribution centers with microfiche files may play a role.

Some changes in information and fact handling can be anticipated because intellectual processes are regarded as a major problem to be solved (through design

and commitment more than hardware/software improvements). NTIS has a goal to provide indexing (data tagging) to indicate the availability of graphics and tables with addressable numeric retrieval parameters.

3.2 Organizational Structures and Affiliations

Organizationally, NTIS is likely to remain a strong, centralized agency. As the volume of service increases, and, if effectiveness considerations dictate, it is possible that NTIS will decentralize its distribution functions. Foreign distribution centers are likely to precede decentralized domestic distribution centers.

There is no indication that NTIS will not continue to increase the number of formal affiliations whereby NTIS acts as a central marketer for the non-military technical reports of those agencies which do not now have a major distribution facility of their own. There may even be a consolidation of functions under NTIS which would result in transfer of information responsibilities from independent agencies to NTIS.

The increase in the volume of civilian agency input will not replace the value of DoD input to NTIS.

3.3 Economics and Marketing

NTIS exists to provide a single outlet for Government information products of commercial or technical interest. NTIS recovers 98% of its costs through sales. Although costs for Government reports have gone up, and although NTIS charges have reflected these cost increases more than Government report distribution facilities which are not on a cost recovery basis, the customer base continues to grow. Acceptance of the cost recovery policy has been slower among those users who have been accustomed to nominal charges, such as those in the aerospace and defense communities.

NTIS has no policy limits on its market. It has actively developed new markets through:

1. marketing agents in foreign countries

2. development of some special purpose products for special clients

As a matter of policy, NTIS does its own marketing. Attempts to market NTIS products through industry (e.g., McGraw-Hill and Baker and Taylor) proved unsatisfactory. It is unlikely that there would be any effort to revive such a plan. On the other hand, NTIS does act as the wholesale marketing agent for government software and data bases which are retailed by industry (such as MEDLINE and TOXLINE). If there are new computer products developed, industry/Government cooperative arrangements for their use are apt to be negotiated through NTIS.

NTIS often competes with the Government Printing Office. Some Federal agencies distribute materials through both sources and GPO often has a lower per item cost. In other ways, NTIS competes with private industry by doing its own marketing of products.

3.4 Scope of Services

NTIS impact is likely to become broader and more expansive in scope (more agencies and subjects). Secondarily, it may develop specialized services for particular clientele. It is possible that when an agency and a special user are willing to pay for the development of specialized products (numeric or factual products rather than bibliographic products) NTIS would cooperate in such ventures.

4.0 CONCLUSIONS

The role for NTIS in the decade 1978 to 1988 is apt to be very similar to its present role. It will act as a major interface between Federal agencies and the civilian business and technical community.

It can be expected to respond to both its agency clients and its customers in much the same way as industry responds to traditional supply and demand pressures. Its policy will be governed by the requirement that it

recover costs. Thus, it cannot be expected that NTIS will assume major development costs or underwrite the cost of information dissemination. The NTIS and DDC functions are perceived differently in that DDC is seen as an extension and integral part of the DoD R&D effort and therefore a cost to be absorbed. NTIS is a distribution agent for public reports with a value to private parties with no direct benefit accruing to the Government through this use. This fundamental difference is likely to encourage independent paths for DDC and NTIS.

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1.0 REASON FOR INCLUSION

The U.S. Air Force Foreign Technology Division (FTD) is responsible for administering the Intelligence Data Services Directorate (NI) for the U.S. Department of Defense (DoD).

NI has been responsible for the development and implementation of many innovative concepts in document processing which have come into common use. FTD was a principal sponsor of automated documents storage and retrieval systems.

As technical information service of DoD, it has organizational ties to DDC. Its mission to the science and technology (S&T) intelligence community parallels DDC's mission to the RDT&E community.

2.0 CURRENT PROFILE

2.1 Technology

FTD employs a centralized computer system with remote terminals configured to process national security information products. Details are not available.

NI's role is to provide documentary information in support of FTD's function of assessing the technical capabilities of a foreign nation.

NI has structured its program to include: an index of the total content of all science and technology documentation; automatic storage and retrieval of documents,with delivery/display in the user's work area; a specialized information system designed for personal use; automatic information correlation and selection techniques; individualized information research service.

NI processes between 300,000 and 400,000 documents per year. Indexing is done with an uncontrolled vocabulary (a thesaurus has been abandoned). Indexing input is manual, followed by mechanical keying to machine readable form.

Full text storage and dissemination medium is generally microfiche. Documents in the system are provided by the intelligence community. Acquisitions include published foreign literature and unpublished intelligence reports, and also, U.S. technical reports classified "Top Secret" and above. Information is disseminated to cleared users only.

2.2 Organization Structures and Affiliations

NI is, by design, an insular information processing agency. It exists to serve other agencies, specifically in defense intelligence. Five agencies control the system content, access and policy: U.S.A.F. FTD; Foreign Science and Technology Center; Missile Intelligence Agency; Medical Information and Intelligence Agency; and U.S. Navy Intelligence Support Center. Other agencies with access include the Central Intelligence Agency and the National Security Agency.

The agency's mission is directly related to serving its clients. It is assumed that the quality of NI services has a direct affect on the performance of the security agencies served.

2.3 Economics and Marketing

No information available.

2.4 Scope of Services

NI's interests include all scientific and technical subjects of interest to DoD, i.e., all physical science and engineering, some medicine and natural science.

The material collected and processed is all document based. However, research has been underway for several years on automatic information correlation and selection techniques that has led to the development of factual tables and files.

3.0 FUTURE PROFILE

3.1 Technology

FTD is conducting research into several key information storage and retrieval problems: input effectiveness and efficiency, automatic surrogation, output technology, and document delivery.

FTD has a goal to increase the productivity of the input processes by minimizing the need for human interface - both intellectually and technically. The technological roadblock in both aspects is regarded as being the lack of the raw input data in machine readable form. FTD uses an uncontrolled vocabulary and has found that significant cost savings without loss of system effectiveness were possible by discontinuing the use of a thesaurus and human indexers. The present keying of data from coded forms is costly and subject to error. Solutions are being sought in the development of an optical character recognition (OCR) machine capable of multifont processing and automatic input processing. Anticipated lead time for development is ten years. The project is an in-house effort because it is felt that the problem is of little concern to the public sector, where the technology tends to favor the original production of information in machine readable form.

Automatic surrogation is an area where FTD development may also produce improved modes of technical processing. Prospects for successful development favor automatic abstract generation with user oriented variations (intelligence, physics, engineering, planning, etc.), combined with ad hoc structuring of user oriented displays.

In all efforts, pressure exists to cut costs and manpower requirements. Therefore, in any area where technology is able to bring about cost reductions, action will be taken.

Output technology is a high visability area for new developments. The interface with other systems at a remote location is the issue.

FTD's problem is to develop means of making the user an effective part of the system and therefore increasing the relevance of the system. Audiovisual aids and on-line tutorials have been relatively ineffective. Therefore, new measures have to be developed.

Document delivery with speed accuracy and user acceptability is listed as the most significant, technological problem with no present solution in sight. The goal is to have a central microfilm store with remote display and copy capability. The transmission is feasible, but the remote display is a problem because present technology cannot provide adequate resolution for image transmission without intermediate, digital keying. This is essential for display of maps, diagrams, pictures and text.

3.2 Organizational Structures and Affiliations

There are no indications of change

3.3 Economics and Marketing

As a result of technological improvements, costs for operations of present systems are expected to go down.

3.4 Scope of Services

The scope of services is likely to remain substantially the same as long as the NI mission and that of its supporting agencies remain unchanged.

4.0 CONCLUSIONS

Historically, technological developments of the intelligence information processing community have been slow to come to general knowledge. Eventually, however, the impact is felt.

DDC, because of its similar defense orientation may be able to realize the benefit of FTD research early. Therefore close liaison is warranted not only for the immediate benefit it could have for DDC technological capability but to act as a funnel to disseminate the results of unclassified FTD studies to the information processing community as a whole. However, it is likely that DDC would have to take the initiative in such action as FTD would have little reason to do so.

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1.0 REASON FOR INCLUSION

INFOCEN is a unique information system in that it is a data management system centrally supported technically, but closely controlled by the user in content, output and other user aspects. This user may be an individual or an authorized group. The system's appeal lies in its flexibility and freeform data structure, rather than in any unique subject content, efficiency factor or relevance. It is an automated, interactive personal file system that is functionally analogous to office files but with wide range computer manipulation capability. The system is particularly interesting because it was designed with significant assistance from its first user group (AF Avionic Laboratory scientists) and as an apparent result contrasts strongly in design with traditional systems.

2.0 CURRENT PROFILE

2.1 Technology

INFOCEN is a generalized, computer controlled, interactive information handling and processing system. Twenty-two data bases are centrally maintained in INFOCEN format. Customers define their own scope and select some system options such as type of remote site terminals and modes of operation (e.g., interactive update or remote data collection).

The central processor is an IBM 370/155 general purpose computer. However, the software is intended to be independent of the operating systems: DOS, OS-MVT, DOS-VS,

tended to be independent of the operating systems: DOS, OS-MFT, OS-MVT, DOS-VS, OS-VS1 and OS-VS2; and it is currently undergoing modification to run on a DEC-PDP/11.

A variety of devices can be used for remote site terminals, depending on the application. Options range from MCST devices to color CRT's.

The system executive has a proprietary set of access methods for tape, disk and teleprocessing. Its own virtual storage administrator is used in support of its interactive modules. The system is said to have throughput advantages resulting from an optimal use of the same core memory by all terminal users which reduces the overload normally associated with teleprocessing systems.

Data base storage is on disc and all data are packed at maximum density which assumes 100% fill at all times.

INFOCEN policy limits the size of the centralized data bank to 100,000,000 characters. The largest file is now 250,000 characters and the smallest 25,000. The system utilizes 32 disc drives.

TYMNET (TYMSHARE, Inc.) communications are used to support more than 150 terminals (e.g., RJE, MCST, MTST, card readers, and CRTs).

(Data/Central) Information Handling System is the proprietary software system used by INFOCEN. It is a product of Mead Technology Laboratories, Dayton, Ohio. The system was originally designed for the AF Avionics Laboratory but it is now marketed for general use.

Mead classifies the software as a multipurpose information system with data base management features, text retrieval and document handling features and teleprocessing modules.

INFOCEN, as such, is neither a document handling or fact handling agency. No central control is exercised over the content of the data bases. All application specifications are designed by the user.

2.2 Organizational Structure and Affiliations

INFOCEN is now regarded as a fully operational system of the U.S.A.F. Aeronautical Systems Division (AD) which is part of the U.S.A.F. Systems Command. It is maintained by the computer center at Wright Patterson, AFB. Users are located across the United States, and represent all operational levels of the U.S.A.F.

U.S.A.F. MASIS Directorate has sponsored the development of interactive MASIS, a file utilizing INFOCEN. Duplicates of all work unit descriptions (DD 1498) which are sent to DDC are also sent to INFOCEN to be included in the systems. This is because of INFOCEN's capability of free text search and retrieval.

The system started as an R&D project at the U.S.A.F. Avionics Laboratory in 1968. Scientists at the Laboratory worked with the contractor (Mead) to provide a free text retrieval system. (Data/Central) was a result of that effort. In July 1975, it was assumed as an operational system by AFSC/AD.

2.3 Economics and Marketing

INFOCEN is an unfunded operating system. Users pay the full cost of the system, including data base development, storage, update, analyst time, production control and a fixed fee prorated by use to cover the cost of overhead and the contractor costs.

Detailed costs for operation are not yet available since full operational status is only a recent occurance. Overall operating costs for FY 1975 were $1,100,000 including $300,000 for hardware leases.

2.4 Scope of Services

The content of the data base is determined solely by the user. Applications have been made in a variety of situations including the MASIS file for RDT&E managers; the Armed Forces Procurement Regulations; Freedom of Information File

(for the Assistant Secretary of Defense, U.S.A.F.); AFSC Personnel File (search keys and full text resumes of officer employees over GS12); and 100 "private" file users. The private files maintained by authorized personnel (most laboratory personnel) are personal records including research notes, project reports, and other materials that might normally be part of an office file.

There are presently 500 users supported through 150 terminals.

3.0 FUTURE PROFILE

3.1 Technology

In its present state, INFOCEN is expected to become rapidly saturated since it is limited by physical aspects of the INFOCEN computer system and policy controls on the size of the storage. There are no definite plans for technological changes to accommodate significantly greater use. Issues outlined by INFOCEN as key to the technological future are:

1. As the number of customers increase, the retrieval time, as well as turnaround time, and response time increase. Users at peak times have to wait several minutes for response whereas now they are accustomed to virtually immediate response.

2. Hardware updates are required from an IBM 370/155 to a model 165 or 168

3. The software is proprietary

4. Trends in storage costs are expected to continue sharply downward.

3.2 Organizational Structures and Affiliations

At this stage of INFOCEN development it is not possible to foresee its eventual organizational placement in the information community. Prospects are regarded as excellent for steady, constant growth of INFOCEN as a single, central processing organization with an increasing number of terminals serving many DoD customers. The growth can be expected to proceed in steps. At each step, when the system capacity is reached INFOCEN will plateau until sufficient demand builds up to proceed to a level of greater service volume.

3.3 Economics and Marketing

There are no plans for an active marketing effort at INFOCEN. It is

expected that the system will grow normally at a pace equal to the ability of INFOCEN to provide adequate service. Cost is the major contingency factor and the benefit value of the system is particularly difficult to demonstrate because INFOCEN is so conceptually different from traditional systems, which have less user involvement in input, update and maintenance activities. As a result, INFOCEN costs tend to stand out. If costs continue downward, the viability of the system is likely to be ensured. On the other hand this visible nature of the costs could make the system suseptable to accross-the-board spending reductions.

3.4 Scope of Services

No information is available.

4.0 CONCLUSIONS

INFOCEN has many features that are likely to characterize future information systems. For example, it is highly personalized, interactive and unrestricted by code tables and rigid forms. Its design presumes that individuals are capable of effectively utilizing a costly personal retrieval system. This may not be a valid assumption.

It is impossible to predict the individual roles of INFOCEN or (Data/Central) in 1988 because there are too many political and economical factors that affect the desirability and feasibility of specific systems in specific environments. However, the experience gained from such systems should provide pragmatic feedback to systems designers to indicate features that are user oriented. INFOCEN will contribute to that experience.

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1.0 REASON FOR INCLUSION

MASIS is an operational management information system which was developed within the Office of Aerospace Research prior to the OAR/AFSC merger. Under OAR, MASIS documented the Defense Research Sciences and Environment Programs and continued operation when merged with AFSC in July 1970. In September 1971, MASIS was expanded to include the exploratory and non-system advanced development programs. It is now the primary central source of management scientific information for AFSC R&D program managers, which is the Air Force component of DoD's RDT&E management information environment.

2.0 CURRENT PROFILE

2.1 Technology

MASIS is a batch process management information system which collects and manipulates project control data for on-demand and periodic reporting.

The system uses a dedicated IBM 7010/1401 computer system under control of a data base manager developed in-house. The MASIS processor accesses the data base through an IBM 370/135 computer. On-line, interactive access to a subset of the MASIS file containing summary project descriptions is provided by INFOCEN, an AFSC interactive retrieval system maintained at Wright-Patterson AFB. INFOCEN is described separately in this report.

Input to MASIS is recorded and retained at the funding action level in 15 reporting laboratories. All funding actions are controlled by a basic contract or grant record which automatically links all follow-on contracts. For

retrieval, data may be summarized at several levels: contract, work effort, task, project, subelements or technical domain, program elements, and source of funds. A flexible report generation program is used for report formatting.

Data preparation personnel within the laboratories extract and input the required data from various internal documents in the normal course of work.

The system consists of four master files:

1. Proposal file - status and final disposition of 14,000 unsolicited proposals
2. Fiscal - 30,000 records of variable length describing the work unit monitor, performer, contract description, grant, in-house work unit, and fund transfer, and data elements that describe each funding action.
3. Publication - bibliographic information on 49,000 technical reports (DD 1473) and other AFSC research effort products
4. Narrative - paragraph description containing 100 characters of identifying information and up to 2100 characters of narrative text. It uses an extended upper/lower text character set. The narrative can have one unclassified record and one classified up through secret. The information is given in accordance with AF security requirements.

MASIS has eight types of records.

1. AFSC Scientific and Technical Work Efforts
2. AFSC Manufacturing Methods Program Work Efforts
3. R&D Performed or Monitored by other Government Agencies and Supported by AFSC Funds.
4. Acquisition of Supplies, Equipment, and Non-scientific Services with Domestic Educational Institutions
5. Acquisition of Supplies, Equipment and Non-scientific Services from other than Domestic Educational Institutions
6. Research Procured for Non-reporting Activities
7. AFSC R&T Work Efforts Submitted to the National Security Agency
8. Internal Staff Summaries

Only records 1, 2, and 4 are submitted to the DD 1498 Work Unit Information System of DDC.

The MASIS retrieval subsystems are designed to provide a variety of custom tailored reports from the data bases.

2.2 Organizational Structures and Affiliations

MASIS is a service unit of AFSC designed by and for R&D program managers. It is funded as a line operation and its prime obligations are to AF management at Headquarters and in the 15 reporting laboratories.

Subsets of its files on magnetic tape and its programs are available to authorized Government users when requested. MASIS provides duplicate, summary files to both DDC for the WUIS data base and to INFOCEN for the Interactive MASIS.

The system dates from a contractual research work effort (Project ECHO) sponsored by the Air Force Office of Scientific Research (AFOSR) in 1959. It became operational in 1963 as the Management Control Data System. During 1965, the system was expanded to include all the activities assigned to the Office of Aerospace Research (OAR) and became MASIS.

MASIS functions are to provide a centralized automated data bank for integrating management and scientific information related to AFSC laboratory programs, and to provide a flexible retrieval capability to satisfy command and laboratory requirements for management information. MASIS coordinated the Air Force component of DDC's management information program.

2.3 Economics and Marketing

No information available.

2.4 Scope of Services

Project and proposal status reported by AF research laboratories is structured and reported to a community of prime users consisting of:

1. Headquarters, Directorate of Science and Technology

2. Directors of Science and Technology in the reporting laboratories

3. Middle management and support service personnel

4. Operating level managers

MASIS reports all project status information including both bibliographic (reports published) and non-bibliographic (funding and progress status). The reports are custom tailored to the requirements of the research laboratories served and can be current or historical.

3.0 FUTURE PROFILE

3.1 Technology

Current plans for MASIS call for translating the system currently operating on a dedicated IBM 7010 with an IBM 1401 for off line printing, to a tenant system of the AFSC Honeywell 6060. The project is part of the Air Force program to make all its computer components compatible within a World Wide Military Command and Control System (WWMCCS). MASIS is not intended to be part of the actual WWMCCS network, however.

The MASIS changeover will proceed in steps from its current batch mode to an interactive mode by 1980.

The major technological roadblock is the lack of a large scale machine to efficiently dual process timesharing and batch systems. One possible solution is envisioned in a distributed type of operation utilizing microprocessors with integrated circuitry to perform processes that today are software dependent. The local, smaller, faster hardware devices would provide the first interaction task processing.

A key long range goal of MASIS designers is to develop a system for solving objective management problems in a clear, unambiguous way so that the managers can spend time on assessing the human aspects of management problems.

3.2 Organizational Structures and Affiliations

MASIS plans to maintain its current organizational profile. Its function will be to provide project control support. This function at the operating level is not seen as one which can be served well from a central operation, such as DDC.

3.3 Economics and Marketing

In the short term a resource allocation conflict between operations and development to translate the system to the Honeywell 6060 is expected to exist. Beyond that MASIS is expected to remain a Headquarters funded, viable operation with expanded capability. Expansion will follow the requirements defined by R&D program managers.

3.4 Scope of Services

The scope of MASIS is clearly defined by directive. There is no indication at the MASIS directorate level of any pending plans to change its orientation or its products, other than to achieve an interactive system by 1980 to improve the currency and precision of the data reported to MASIS.

4.0 CONCLUSION

While it is conceivable that a central, DoD management information system may evolve to serve the needs of DoD at the highest level (e.g., Director of Defense Research and Engineering (DDR&E)), there will still remain a need to provide a working level system. Preliminary, incomplete project information which is very useful at the operating level is only misleading the higher it goes up the line of command, and line managers are reluctant to feed such information into a system without significant control over its use.

MASIS, as the central contact in the U.S.A.F. for managment information would be its agency for implementing the U.S.A.F. interface with a central management system should that be required by DDR&E; but the stimulus for such a move is not likely to be generated within the U.S.A.F., given the present environment.

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1.0 REASON FOR INCLUSION

The Army Library serves an important, atypical DDC audience: it provides traditional library services to the Office of the Secretary of Defense rather than to the type of science and technology audience typical of DDC. The Library is actively pursuing a automation program for various library functions (Army Library Automated Systems - ALAS). On-line, DDC services are an integral part of the plan.

2.0 CURRENT PROFILE

2.1 Technology

The Army Library's automation program (ALAS) is in various stages of planning and development. A three to five year feasibility study is currently in progress (due November 1975). The study is directed at mechanization of library functions: namely circulation, journals, interlibrary loan. Major alternatives are a time sharing operation, versus a minicomputer (e.g., a PDP 11), versus batch support from the U.S. Army Management Systems Support.

Current applications include:

a. Ohio College Library Center (OCLC) cataloging and support systems. Although the system is operational it is still regarded as part of the "Federal Library Experiment in Cooperative Cataloging" (FLECC). The system utilizes two OCLC Beehive terminals.

b. Two DDC terminals (Uniscope 100) are in the Library - one classified, one unclassified. Replacement of the unclassified terminal with an SDC or Lockheed terminal is under consideration.

c. USAMSSA now supports these functions: purchase orders, a periodical holdings list and separate listings for the Army Staff agencies' subscriptions ordered through the Army Library

2.2 Organizational Structures and Affiliations

The Army Library serves the Office of the Secretary of Defense (OSD), the Department of the Army, and DoD personnel located in the Pentagon and in the Military District of Washington without access to library service. Additional responsibilities include: coordination with the Office of the Judge Advocate General in providing technical support worldwide to Army field law libraries; coordination with Office, Chief of Staff, Army (OCSA), in monitoring the Army Study Program; publications of bibliographic surveys at the direction of OSD and OCSA.

Funding for operations is provided from OCSA ($895,000 in FY '76) and R&D funds are secured from various agencies of the MDW, e.g., the current automation feasibility study. The FLECC project is a Federal Library Committee project. The Army Library provides support by a transfer of funds in two ways:

a. to the Library of Congress Federal Library Committee for administration and billing costs

b. to the Smithsonian Institution for telecommunications costs

Historically, the Army Library has existed since 1947. Its beginnings were in a consolidation program of 28 scattered War Department Libraries into one "War Department Library" at the Pentagon in 1944. It has operated under the Secretary of the Army, 1947-1955; the Adjutants General's Office, 1955-1973; and now under the Military District of Washington.

2.3 Economics and Marketing

Costs for all services are, as a matter of policy, absorbed by the Library. The cost for services (such as SDC, Lockheed or the NY Times information services) are not considered prohibitive. The major economic problem is to get staff and money.

Current marketing efforts are principally limited to the distribution of "interesting" user brochures. From the management side, a major problem is to demonstrate the benefit and utility of the Library.

The Army Library is in a non-competitive position for its funds and its market. By directive it has no competition because the Army prohibits it.

2.4 Scope of Services

The Army Library is maintained as a repository of current and frequently used materials in pertinent fields of official interest such as military art and science, international relations, government, economics, administration, social and physical science, history, geography, biography and law. Materials include 2[illegible],000 to 280,000 bound volumes, 200,000 subscriptions and 1,000,000 documents.

Daily use is estimated at 1,000 phone and personal requests for service. The Library deals directly with its users and encourages do-it-yourself research through open shelving and liberal provision of work areas which are actively used.

The Library provides bibliographic services, library reference, hard copy, and microform.

3.0 FUTURE PROFILE

3.1 Technology

The current automation feasibility study is the key to the Library's development plan.

Basically, the Army Library will continue to refine its current operations. No basic changes are anticipated in the technology employed. No efforts will be undertaken to develop any unique technologies. Expanded access to commercial data bases is likely:

a. SDC or Lockheed

b. NY Times (previously discontinued due to adverse pricing policy changes)

Technologically the Army Library wants to see DDC develop a more sophisticated, operational "TEMPEST" configured terminal for simplifying access to classified information. It would eliminate the need for the Library to provide a "secure" room to house a classified terminal.

The Library regards the DDC files as not being user oriented. Because of

complex access procedures and inconsistencies in the files (e.g., where different field codes are needed to access the author field in DROLS and WUIS and author names are not standardized) it is necessary for the foreseeable future to have library personnel act as an intermediary between the information systems and the ultimate users. Such problems are perceived as "people" problems, not technical ones.

For the future, technological issues and attitudes of concern to the Army Library are:

1. The Army Library needs a rationale and unit of measure to demonstrate benefits

2. users should be able to have a portable terminal not larger than a brief case with a standard, dial-up capability to access information files

3. facsimile transmission is ultimately desirable

4. standard terminals are important. Costs are too great if every application needs a new terminal

5. OCLC should be the basic model for library automation. If it can't handle it all, then the Library of Congress is expected to spearhead a duplicate development effort for Federal Libraries

6. ARPA is research oriented and should be the DoD agency to provide the leadership that develops new information systems

7. the key technological problem is regarded as the need for standardization across all aspects of the information and library science field

3.2 Organizational Structures and Affiliations

No change in the organizational profile of the Army Library is foreseeable.

3.3 Economics and Marketing

Costs for services will continue to be absorbed by the Library. Technology will be employed to a greater extent to either reduce unit costs for operation or maintain a no-increase operation cost with expanded services.

3.4 Scope of Services

The Army Library will maintain the posture of a traditional special library. New materials and information service will be employed as they become

available as well as any new modes of services.

4.0 CONCLUSIONS

In the decade 1978 to 1988, the role of the Army Library is unlikely to change directions. Its relationship to DDC is that of a user, one of many. Its role in the Federal Library community is more significant for any leadership which the Army Library may demonstrate. The library's parochial mission will have to dominate its policy.

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1.0 REASON FOR INCLUSION

MARDIS is the U.S. Army (U.S.A.) R&D management system which has been under development since 1973. Since the summer of 1974 an automated version of MARDIS, referred to a "Prototype II", has been in operation. MARDIS is regarded as a vertical information system providing multi-level management information support to Army R&D managers in the field and at headquarters. It is designed to support budget formulation, phase schedules, and resource apportionment processes in R&D through collecting, formatting, and dissemination of funding, performance and milestone data. MARDIS is the Army component of DoD's RDT&E management information environment.

2.0 CURRENT PROFILE

2.1 Technology

MARDIS is a batch system. It consists of 25 separate computer programs written in ANSI COBOL. It is machine independent. The programs all access a common data base called the MARDIS Master File. Twenty one of the programs are report generators and four perform maintenance functions. The edit/update program is used to add, delete or update records on the master file. Data is collected at the project and task level. Financial data is passed from the task to the project level through the edit/update program.

A master file is created at every organizational level in the Army R&D community. Above the laboratory level, the master file is a merger of the master files from the lower echelons.

The automatic digital network (AUTODIN) is the Army communication network used for transmitting master file changes to higher and lower levels in the system. The network accommodates MARDIS punched cards or magnetic tapes. Changes to the master file are simultaneously written to the master transaction file as they are received at each organizational level. The master transaction file at each site serves as a historical record and audit trail for MARDIS.

One disc is required for storage of the MARDIS programs, library routines and external files. Depending on the size of the local master file, one additional disc may be required. Backup storage is on magnetic tape. 10 years storage is required by directive.

The software for MARDIS was developed under contract by Computer Systems Corporation and is available to authorized users.

2.2 Organizational Structures and Affiliations

MARDIS is designed solely to assist Army RDT&E managers through the collection and processing of planning information. MARDIS reports are used to support the allocation of constrained resources to maximize the Army's R&D objectives. In particular, MARDIS provides RDT&E managers with projected performance, resource requirements and milestone data in three areas:

- Budget information
- Phase schedule (milestone progress)
- Apportionment (RDT&E distribution process)

Prior to 1973 when MARDIS development was begun, the Army equivalent was simply an accounting system and a limited project descriptive system (based on DD 1634). It was a headquarters system only.

2.3 Economics and Marketing

MARDIS is still in an experimental mode, and therefore, does not incur annual operations costs. The projected costs, according to its two and one half years experience, are $3.5 million to be expended over a nine year period. The goal is to become functionally operational at all levels by Fall 1976.

2.4 Scope of Services

The content of the MARDIS files is a variety of data elements at two levels corresponding to the Army RDT&E classification scheme. The basic structures relate to Single Program Element Funding (SPEF), the non-SPEF, and the stand-alone project. The basic unit of description is the project level, which is the fundamental structure of the Army RDT&E program as described by the Army budget project number.

MARDIS users are the RDT&E managers concerned with budgets, schedules and apportionment at the Army's 12 data processing installations and 44 R&D Directorates. Part of the MARDIS record is used as input to the DDC Work Unit data base.

3.0 FUTURE PROFILE

3.1 Technology

MARDIS is classified as an experimental system with a projected development period of nine years. It is too early to predict the characteristics of the eventual system. It is expected to develop into a fully interactive system by 1985. The basic structure of MARDIS is compatible with that trend. Assumptions that characterize the present thinking are:

a. stringent accountability requirements are not likely to change

b. the Army trend is to reduce the extent of support service

c. MARDIS will replace many functions that are now performed by centralized action officers.

d. MARDIS will need to have some type of data base manager to permit personalized formatting of reports

e. some of the strict structuring and rigid format of MARDIS will be replaced by more free-form interaction

f. MARDIS is still too complex for general utility and it needs to be improved so that its response and the acceptability of its content is equal to or better than that which can be done without the system.

3.2 Organizational Structures and Affiliations

MARDIS is committed to a decentralized structure with hierarchical relationships. It is capable of providing information to all levels of management. It is planned that MARDIS will provide input to DDC's planning system by producing planning summary input (DD 1634) as a MARDIS by-product.

3.3 Economics and Marketing

During the development stage of MARDIS, it will be necessary to demonstrate the usefulness of report information in decision-making. It is hoped that MARDIS can make its users comfortable with the system through demonstration. The big breakthroughs are seen as social factors. As people are generally exposed to information systems in daily life, users of MARDIS are expected to provide the feedback on system use that will lead to people oriented systems. MARDIS designers have attempted to build sufficient flexibility into the system to render it capable of responding to that impetus. Responsiveness to user feedback would then reinforce confidence and general use of MARDIS by the time its development is complete.

3.4 Scope of Services

There is no indicator at the directorate level that a change in MARDIS' scope of service is forthcoming.

4.0 CONCLUSIONS

Two possibilities exist for the future role of MARDIS. Both assume that constraints on availability of service personnel will continue. If the constraints are extremely severe within DoD as a whole, it is conceivable that a

more centralized reporting system would evolve out of DDR&E. In such an event, MARDIS could be abandoned or reduced in scope before its development is complete.

On the other hand, if the constraints are less severe and each service branch is left to solve its own management problems, MARDIS is apt to become a tool for replacing intermediary managers and receive support for full development. In this event, MARDIS could evolve into a reporting system for management control with direct interface at DDC and/or DDR&E.

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1.0 REASON FOR INCLUSION

The U.S. Navy's (USN) approach to information service support represents an alternative to that of the other branches. The function of providing a centralized source of bibliographic and management information is delegated to the Defense Documentation Center. The Navy Technical Information (NTI) Office acts as a focal point to represent the Navy requirements for information support to DDC.

2.0 CURRENT PROFILE

2.1 Technology

NTI relies exclusively on DDC for information processing of both technical and management nature.

The mainstay of the technical information program is DDC's Defense RDT&E On-Line System (DROLS) terminals. Fifteen DROLS terminals are operational at Navy facilities including Headquarters, Naval Material Command, the Naval Electronic Systems Command, R&D Centers, the Naval Academy and the Naval Postgraduate School. Use at all centers is increasing.

The function of the Navy Work Unit Information Service (NAVWUIS), as the centralized recipient and forwarding center for processing Navy Research and Technology Work Unit Summaries (DD 1948s) for input to DoD Work Unit Information Data Base at DDC, was terminated in late 1974. All Navy contributors to the DoD

Work Unit Information Data Base at DDC now transmit Navy Research and Technology Work Unit Summaries directly to DDC. Decentralization of Navy work unit processing and direct input of work unit data to DDC is expected to considerably reduce time-lag in, and increase currency of, Navy Research and Technology Work Unit Summary reporting.

Input to DDC WUIS is provided on magnetic tape by the 10 target Navy R&D laboratories under the Chief of Naval Materials. Others submit appropriate information on the standard work unit reporting forms (DD1498).

2.2 Organizational Structures and Affiliations

NTI is a line function of Naval Material Command, but funding for RDT&E information programs is provided by the David W. Taylor Naval Ship Research and Development Center in Bethesda, Maryland.

Formal arrangements are in effect with DDC to provide information systems as described in Section 2.1. In addition, NTIS is used as a distribution agency for all USN technical reports of interest to the civilian public. Naval Material Command R&D Centers have authority to develop local data files according to local needs.

Historically, the management information role had been carried out until 1974 by the Navy Work Unit Information Service (NAVWUIS) at the David W. Taylor Information Systems Division. Prior to that, the program had been the Navy Automated Research and Development Information System (NARDIS).

The mission of NTI is to assure a Navy interface for information transfer between the Navy, industry, and the public; and to provide for the R&D information necessary to carry out the Navy's technical projects - both technical and management.

2.3 Economics and Marketing

No information available.

2.4 Scope of Services

The NTI service is a coordinating office for information programs, and as such, provides no centralized Navy information service. Information programs of the Navy, coordinated by NTI include: NARDIC, the Navy interface with industry and not-for-profits (provides Navy requirements to 800 industry, small business representatives, universities and not-for-profit institutes); technical and management information support (through DDC); public release of technical information (including conforming with the freedom of information act); the independent research and development program; technology transfer; the Shock and Vibration Information Center (the Navy's information analysis center which is 50% supported by subscriptions to its services); and the Government/Industry Exchange Program (GIDEP).

3.0 FUTURE PROFILE

The Navy plans for development of improved information services depend on the capability of DDC to implement programs that satisfy a set of Navy priorities.

NTI anticipates that efforts in this part will result in modifications to DDC services which reflect its priorities and requirements by the end of FY 1976. Lack of response would bring about a reassessment of its decision to rely on DDC for management support services.

NTI priorities are:

1. On-line support
2. IR&D information system
3. Planning system (DD 1634)
4. WUIS (DD 1498)
5. Information analysis centers

An overriding concern is that DDC places too much emphasis on bibliographic and library functions and too little on providing management information to support RDT&E manager's needs.

Suggestions that were made include designating DDC marketing representatives to deal with major customers such as NTI; utilizing current technology such as

computer output microfilm to produce specialized information products defined by users; and utilizing some of the systems and software developed in local labs to increase the utility of existing data files (e.g., the Naval Electronics Laboratory's software management system).

APPENDIX B.

INTERVIEW GUIDE

INTERVIEW GUIDE

DoD/DDC Interagency Survey

I. Focal Issues

- Where are you today?
- Where are you planning to be by 1988?
- How will your agency fit into the overall information community in the decade 1978 to 1988

II. Target Projection Areas (1978-1988)

A. Technology employed

B. Organizational Structures and Affiliations

C. Economics and Marketing

D. Scope of Services

1. Content
2. Audience
3. Products and packaging

III. DDC Interfaces and Role in the 1978-1988 Environment

A. Technological interface

B. Organizational interface

C. Economics and marketing

D. Impact on DoD user service

1. Technology

A. Computer Technology

1. Hardware

a. Main Frame (CPU)

- Capacity of 1^{o} Storage (Core Size)
  - On-line capability and limitations
- Throughput Speeds
- Cost
- Compatability Factors/Stds

b. Peripherals

- 2ndary Storage
- Communications Processors
- I/O Devices

(1) CPU

- rdrs
- printers
- COM
- tape
- disc
- plotters/graphics

(2) Distributed

- RJE
- Terminals

2. Communications

a. Type of Access

- dedicated lines
- dial-up
- special considerations

b. Cost

c. Capacity/Band Width

d. Switching/Configuration

- distributed
- star
- decentralized

3. Software

a. Executive

- Compilers Supported
  - (1) Off the Shelf
  - (2) Unique - In-House Dev.
- Processing Modes Supported
  - (1) On-Line
  - (2) Batch
  - (3) RJE

b. Applications Software

- Data Base Mgmt: File Mgmt Statistical Reporting
- IS&R: Search and Retrieval
- Communications
- Reporting and Publications

B. Document Handling Technology

1. Document Surrogate Handling

a. Surrogation (Preparation of Surrogates)

- nature and content of surrogates
- source of surrogates (acquisition)
- volume and rate of growth (per year, etc.)
- method of surrogation
  - machine
  - manual
- c/o of collection surrogated

b. Method of Storage

- media
- formats
- volume (size of file) and time span covered

c. Access to and Dissemination of Surrogate File

- Currency/Periodicity
- Media
- Formats

2. Full Text Document Handling

a. Acquisitions

- acquisition policy and procedure
- formats/media

b. Storage

- volume

c. Dissemination

- volume

C. Fact Handling

1. Acquisition

- nature of facts
- source of facts
- volume and rate of growth
- method of data description
- % of input described

2. Storage

- media
- format
- file size and time span covered

3. Dissemination

- currency/periodicity
- media
- formats

II. Organizational Structures and Affiliations

A. Affiliation

1. Government

- Parent Agency

2. Commercial (for Profit)

3. Not for Profit

4. Academic

B. Funding Sources

C. Cooperative Arrangements

a. Formal

- Interagency Agreements
- Direction (unidirectional? Bidirectional?)
- Nature and Extent

barter?

fund transfer?

b. Informal

D. Historical Perspective

E. Organizational Configuration

F. Management Considerations

1. Mission
2. Key Objectives
3. Means to Measure Progress vs. Objectives

III. Economics and Marketing

A. Costs for Services

- operating expenses
- implementation costs

B. Costs for R&D

C. Costs of Marketing, P.R.

D. Funding/Income Sources

1. User Charges (% of Budget)
2. Subsidies (% of Budget)
   - grants
   - direct funding

E. Economic Viability/Profitability

F. Marketing

1. Product
2. Place
3. Promotion
4. Price

G. Competition

1. For Funds
2. For Market

IV. Scope of Services

A. Content (Subject)

B. Audience

1. Wholesale vs Retail Orientation
2. Size
3. Nature
4. Limitations (e.g., Classified Documents)

C. Products and Packaging

1. Nature of Services
   a. Bibliographic
      - retrospective
      - current awareness

b. Non-Bibliographic

- retrospective
- current awareness